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## Utah Farm & Home Science Vol. 24 No. 4, December 1963

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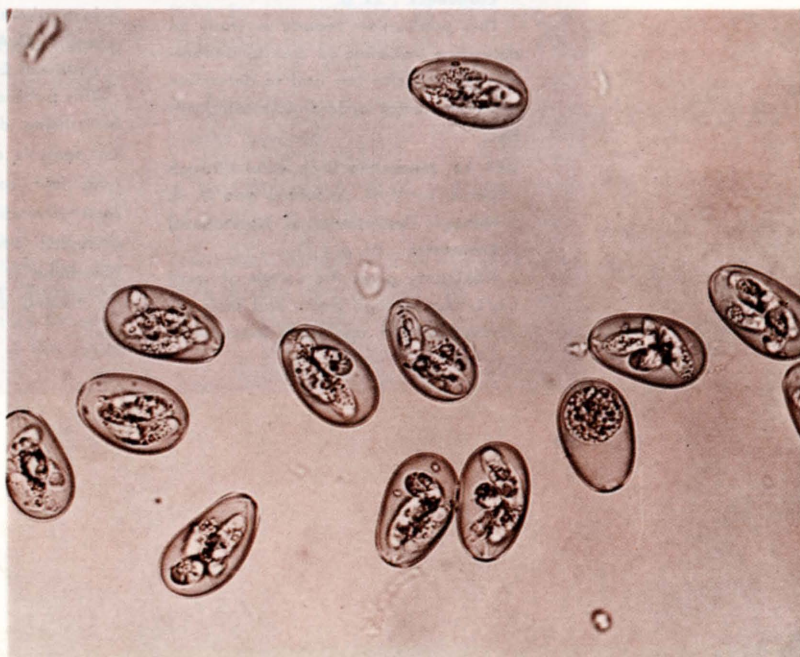
# UTAH



Vol. 24 No. 4  
December 1963

# SCIENCE

AGRICULTURAL EXPERIMENT STATION • UTAH STATE UNIVERSITY • LOGAN





# FARM HOME

COVER PICTURE: At left, two photos taken under the phase contrast microscope showing merozoites, a stage of the life cycle of the coccidium *Eimeria bovis* in calves. The photo above shows normal merozoites, and that below shows merozoites agglutinated by antibodies in the serum from a calf immunized by infection with this species of coccidia. At right, two photos of the oocyst stage of coccidia, concentrated from the feces of calves. These oocysts have undergone development (sporulation) outside the body of the host, and are ready to infect another animal. The photo above shows oocysts of *Eimeria bovis*, one of the species causing coccidiosis, and the photo below shows oocysts of *Eimeria auburnensis*, which is less harmful. The magnification in these two photos is the same. Each sporulated oocyst contains 4 bodies, each with 2 infective stages (sporozoites).

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Work is progressing on the new Animal Husbandry Farm southwest of Logan on Highway 91. About 60 acres of land were leveled last spring. Contracts have been let for leveling a little more than 100 additional acres. Construction of buildings is expected to start in the early spring.

## UTAH FARM AND HOME SCIENCE

A quarterly devoted to research in agriculture, land and water resources, home and community life, and human nutrition and published by the Agricultural Experiment Station, Utah State University of Agriculture and Applied Sciences, Logan.

The magazine will be sent free on request. Address all correspondence to the editor or the authors of the various articles.

Articles appearing in Farm and Home Science may be reprinted if credit is given to the author, Utah State University, and to Farm and Home Science.

## New Publications

URS 17. Cost differentials for marketing eggs of different size lots, by R. A. Christensen and J. McArthur. Department of Agricultural Economics. 22 p.

This publication reports a study to determine variation in cost in marketing eggs by size lots and to determine if volume price differentials are justified.

URS 18. Marketing Utah wool through pools, by R. H. Anderson and D. A. Huber. Department of Agricultural Economics. 24 p.

This study gives the extent of wool marketing through pools and their organization and operating procedures.

It also evaluates the merits of pool marketing and suggests ways to improve methods.

URS 19. Cost of raising dairy heifers in northern Utah, by E. M. Morrison and J. McArthur. Department of Agricultural Economics. 21 p.

This publication presents cost figures for raising dairy heifers followed by an analysis of the factors associated with low cost production. Alternatives available to the dairyman are discussed and a way suggested to determine if income will be greater by raising or buying herd replacements.

Daryl Chase, President  
Utah State University

Wynne Thorne, Director

Kenneth W. Hill, Associate Director

Gladys L. Harrison, Editor

Agricultural Experiment Station



# GROUP FEEDING OF GRAIN CUTS COSTS



**Cuts labor costs,  
time required for  
milking, and  
dust and bother in  
milking parlor**

**E. MAX SUDWEEKS**

**G. E. STODDARD**

**C. H. MICKELSEN**

**I**N STUDIES at the Utah Station, group feeding of grain to dairy cows has not limited the cows' performance as individuals or as a herd. This system not only shortens the time per cow in the milking parlor — such time is costly and comes during peak labor demands — but it also reduces dust and the bother of handling grain while milking.

At the Dairy Experimental Farm cows are now milked at the rate of one a minute. They are fed grain in the silage manger twice a day accord-

ing to herd production. For more than two years this system has not limited the performance of cows individually or as a herd. The herd is producing better than it has in the past. This is not entirely a result of group feeding of grain, but their performance has not been limited by the system.

This change has come about as a result of two tests conducted to determine the response of cows fed individually or as a group.

## *Preliminary test suggests group feeding*

In the first trial during three successive 3-week periods, cows were fed (1) individually twice daily, (2) as a group twice daily, or (3) as a group once daily. Results showed lit-

*(Continued on page 103)*

DR. E. MAX SUDWEEKS, assistant professor of animal husbandry, joined the staff last year after completing the requirements for the Ph.D. degree at USU. DR. G. E. STODDARD is head of the Department of Dairy Industry. C. M. MICKELSEN is in charge of the Dairy Experimental Farm.



# Coccidiosis and Trichomoniasis in Cattle

DATUS M. HAMMOND

THE disease known as coccidiosis occurs in many domestic and wild animals. It is of great importance in chickens, in which coccidiosis is one of the chief causes of losses to the producer. In cattle the disease is less well known than in chickens, but it is estimated to cause \$10,000,000 loss in the United States annually. Coccidiosis occurs more frequently in calves from about 3 weeks to 6 months in age, but older animals, especially those 1 to 2 years old are often affected. The signs include diarrhea, weakness, and lack of appetite. Blood may or may not be evident in the feces. In severe cases, the animals become emaciated, and death or retardation in growth results.

## Nature of coccidia

The agents which cause coccidiosis in cattle, sheep, poultry, and many other animals are protozoa (one-celled tiny animals) of the genus *Eimeria*. The coccidia are unusual among par-

asites in their high degree of host-specificity, that is, the extent to which the parasite is restricted to only one or few hosts. Most species of coccidia live in only a single host, or may live also in one or more closely related animals. Some of the coccidia of cattle are found also in the zebu and water buffalo, but some live only in cattle. Some of the coccidia of sheep occur in goats and wild ruminants as well, but some have been found only in sheep. The coccidia of chickens are apparently limited to a single host.

Another way in which the coccidia differ from most parasites is that often several species occur in a single host. In a recent compilation [Catalogue of Eimeriidea (Protozoa; Sporozoa), Pellderly, 1963], 15 species of *Eimeria* are listed as occurring in cattle, 10 in sheep, and 12 in poultry. A total of 539 species of this genus were included in this compilation. This shows the necessity of distinguishing among the many species. In hosts, such as the chicken, in which careful studies have been made, each species was found to differ in life cycle and in exact location in the host from all of the other species parasitizing that host.

## Coccidia in cattle

Of the nine species of coccidia which have been found in cattle in Utah, the 4 which occur most frequently are *Eimeria bovis*, *E. ellipsoidalis*, *E. auburnensis*, and *E. zurnii*. Only 2 of these species, *E. bovis* and *E. zurnii* are known to cause coccidiosis. Under some circumstances, infection with the other 2 species may cause diarrhea, usually not severe. Information concerning the effect of the other species on the host is lack-

ing, but none of these is considered harmful.

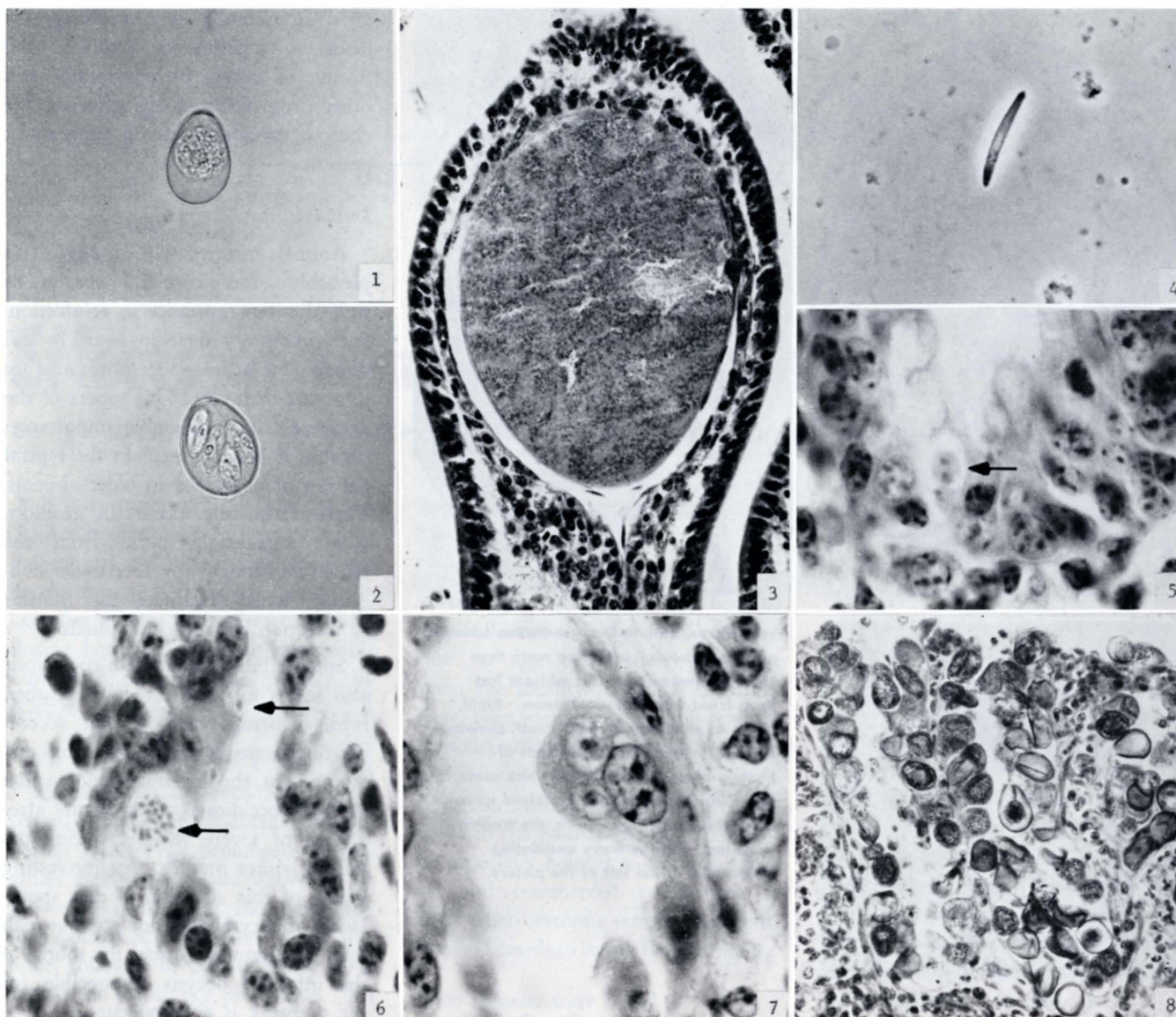
Low-level infection with one or several species of coccidia is normally present in cattle, with no apparent damage to the host. Examinations for coccidia are made by collecting fecal samples, washing these through sieves to remove coarse debris, and mixing with concentrated sugar solution to cause the coccidia to float to the surface. The mixed samples are examined in special glass slides, called McMaster's chambers, under the microscope. In this examination an estimate as to the number of coccidia, as well as the species present, must be determined to ascertain the possible importance to the health of the host animal.

## Life cycles

Coccidia have a complex life cycle, with several generations included in a single cycle. The stage found in the feces is the oocyst, which has a protective wall, resistant to chemical and bacterial action. Oocysts freshly discharged in the feces must undergo a developmental process, called sporulation, before they become infective to another animal. This process requires at least 2 to 3 days and results in the formation in each oocyst of 8 infective bodies called sporozoites. When these oocysts are ingested by cattle the sporozoites escape and penetrate into the intestinal wall. There they enter a tissue cell, start to grow, and become schizonts. Schizonts undergo a kind of splitting process, which results in the formation of numerous new individuals, called merozoites. The merozoites are set free by the breaking of the host cell, enter new tissue cells, and the process is repeated one or more times. In *E. bovis* in-

For about 13 years coccidiosis and trichomoniasis of cattle have been under investigation at Utah State University. These studies have been carried out by the Experiment Station under direction of the author, DR. DATUS M. HAMMOND, head of the Department of Zoology in cooperation with the Animal Disease and Parasite Research Division, ARS. Dr. M. L. Miner, head of the Veterinary Science Department, has actively participated in the study, and Dr. P. R. Fitzgerald and A. E. Johnson, of the Animal Disease and Parasite Research Division, have collaborated in various aspects of the work. In the coccidiosis investigations, emphasis has been placed on the life cycles, immunity, and treatment of certain species; while the diagnosis and treatment of genital trichomoniasis, as well as the relation among the trichomonads occurring in pigs, sheep, and cattle have received attention.





Figs. 1 to 8. Life cycle stages of *Eimeria bovis*. (1) Unsporulated oocyst. (2) Sporulated oocyst, showing 4 sporocysts, each containing 2 sporozoites. (3) Mature first-generation schizont, containing merozoites, in the tip of a villus in the small intestine. (4) Merozoite, released by breaking of schizont. (5) Early second-generation schizont, with nuclei (arrow). (6) Mature second-generation schizont (lower arrow), and merozoites, or early sexual stages (upper arrow) resulting from these schizonts. (7) Two intermediate sexual stages in host cell with enlarged nucleus (at right of coccidia). (8) Section of colon, showing numerous mature or nearly mature sexual stages, including oocysts (note oocyst near center of picture).

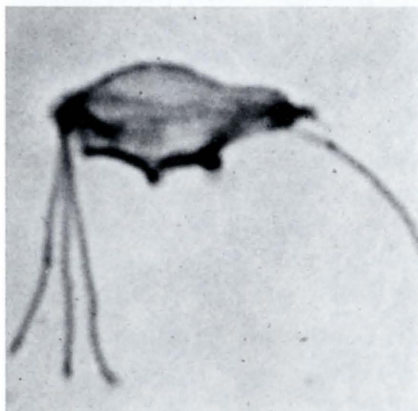
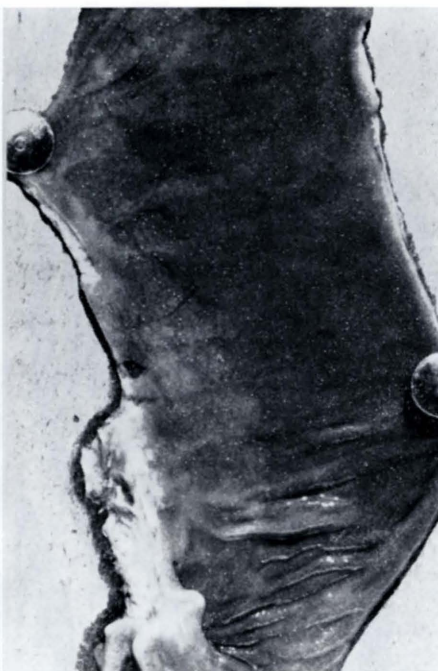
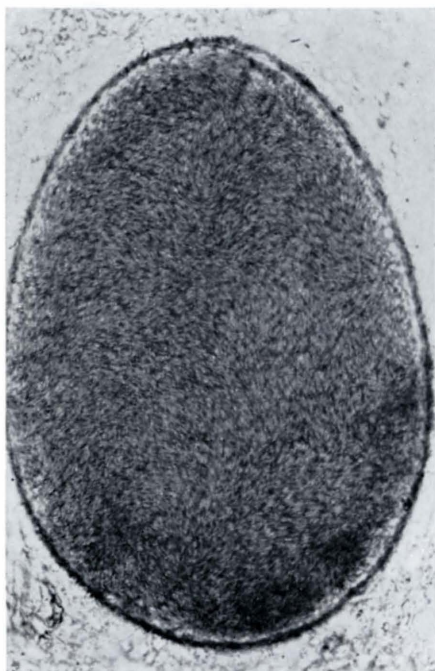
fections there are 2 generations of schizonts, the first in the small intestine, and the second in the large intestine. The first-generation schizont is so large (mean greatest diameter, nearly 0.3 mm) that it can be seen without the aid of a microscope, requires about 2 weeks to complete development, and each schizont has more

than 100,000 merozoites. The second-generation schizont is much smaller (only about 0.01 mm in greatest diameter), contains 30 to 36 merozoites, and requires only 1½ to 2 days to develop.

These merozoites enter new host cells and undergo sexual reproduction, culminating in the formation of

oocysts. This final, sexual generation matures in about 3 days, so that the whole life cycle is completed in a minimum of about 18 days, with the peak in numbers of oocysts discharged coming 19 to 22 days after ingestion of oocysts. The individuals of the sexual generation are much more numerous than those of the previous stages,





Left, above, mature first-generation schizont of *Eimeria bovis*, containing more than 100,000 merozoites. This schizont has been freed from intestinal tissue. Right, photo of small intestine of a calf, showing mature first-generation schizonts of *Eimeria bovis*, appearing as white spots. Left, *Tritrichomonas foetus*, stained so as to show the 3 anterior flagella, the trailing flagellum, and the wavy undulating membrane, at the left of the picture.

and are more injurious to their host cells, causing bleeding and partial destruction of the mucous lining of the large intestine. The signs of coccidiosis usually occur at the same time as the discharge of oocysts.

The life cycle of *E. zurnii*, the other pathogenic species, differs in that no large schizonts occur; the number of schizont generations is unknown. The details of the life cycle of this species and its effect on the host are less well known than those of *E. bovis* because experimental infections can be produced with much less uniformity in the former species. *E. zurnii* seems to cause coccidiosis more frequently in

older animals than does *E. bovis*. In "winter coccidiosis," *E. zurnii* is usually the chief causative agent.

#### Treatment

Various sulfa drugs may be used in controlling or preventing coccidiosis, but treatment is more effective if given before the time of the sexual generation of the parasites. A single dosage of such a drug given 13 days after the beginning of infection in experimental coccidiosis prevents the signs of the disease from developing. Such timing of treatment is, of course, not feasible in natural infections, but early diagnosis and treatment are of

great importance in controlling this disease. Experiments involving the testing in calves of amprolium and other drugs found to be effective for chicken coccidiosis are in progress at present.

#### Immunity

Animals infected with *E. bovis*, and probably other coccidial species as well, develop resistance to reinfection. Such immunity develops quickly and remains for at least several months up to a year or more. This aspect of the disease is of considerable importance, because it helps to explain the typical pattern of outbreaks in older animals. These frequently occur in feedlots, where susceptible cattle from the range are brought together under conditions which facilitate the transfer of infection between individuals.

Susceptibility of cattle to coccidiosis also seems to be affected by weather, feed, or stress, such as that accompanying transportation for long distances. In the intermountain region "winter coccidiosis" often occurs after a spell of severe weather during the fall or winter months. An interesting aspect of this situation is that sporulation of oocysts does not occur at such low temperatures, so that the source of the infective oocysts responsible for the outbreak is not understood.

Development of immunity is accompanied by the formation of antibodies in the blood of the host. However, attempts to transfer immunity by injections of serum or globulin from immune animals have thus far been unsuccessful. The role of the antibodies in protecting the host against reinfection is unknown. Further studies of immunity and other fundamental aspects of coccidiosis are in progress, with the objective of finding information that will be useful in controlling this disease.

(Continued on page 104)



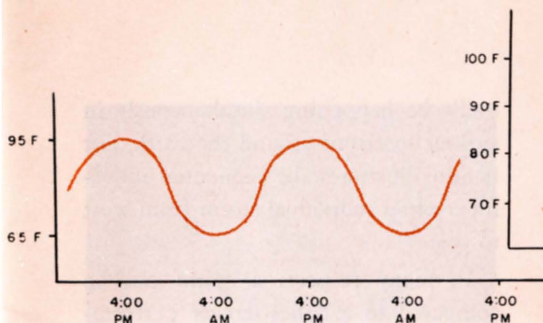


Fig. 1. Controlled temperature fluctuations

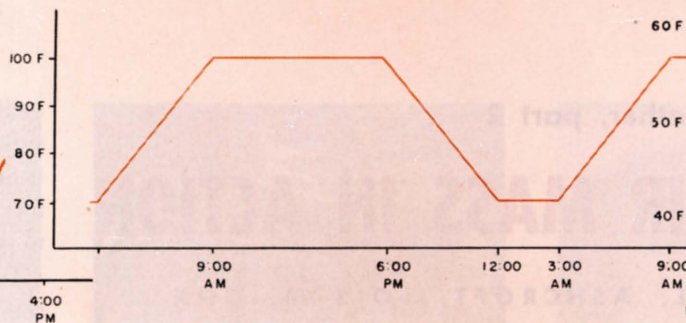


Fig. 2. Daily temperature program

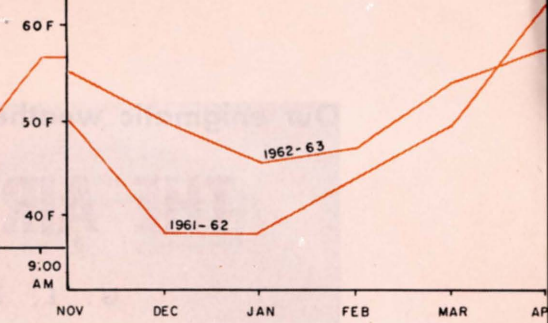


Fig. 3. Average temperature inside uncontrolled house

# Effects of temperature on egg production

C. E. CLARK, H. NIKOPOUR, and C. I. DRAPER

**H**IGH summer and low winter temperatures influence reproduction in chickens. Decreased egg production and excessive egg breakage, due to eggs with extra thin shells during hot weather, cause appreciable economic losses to the poultry industry.

## Temperature affects egg production

Experimental evidence has demonstrated that egg production is adversely affected by prolonged temperatures below 40 F and above 90 F. However, in tests at the Utah Station pullets held at 85-90 F for five hours followed by periods below 60 F showed no loss in egg production. An artificial environment was provided in which daily temperature fluctuations varied from 65 F at 4:00 a.m. to 95 F at 4:00 p.m. and back to 65 F at 4:00 a.m. (fig. 1). Comparing a 4-month period of performance of birds in the artificial environment with those in natural winter temperatures in Logan and with a controlled constant 65 F temperature, no difference was found in egg size, feed conversion, interior egg quality, and egg production. The birds were apparently not under stress in this type environment or they were capable of making the necessary physiological adaptations to permit favorable performance.

*Egg production also influenced by heredity*

Demonstrations at Utah State University have also shown that heredity may influence the relation of temperature to egg production, depending upon the locality in which the birds have been developed. If this can be demonstrated under repeated experiments and under commercial conditions, the information will prove valuable to the poultry industry. It would be especially helpful to poultry breeders and commercial poultrymen in areas where extreme temperatures pose annual hazards to laying flock economy.

## How theories were tested

In these experiments, hatching eggs from strains of White Leghorn chickens, developed over a period of several years at Wyoming and New Mexico Experiment Stations, were shipped to Logan where they were incubated and hatched. The Wyoming strain (S-Wyo) represented birds developed at approx-

imately 8000 feet elevation and at cool temperatures; the New Mexico strain (S-NM) represented birds developed at about 3900 feet elevation and in a warm climate. A third group of birds represented a strain sold commercially in Utah (S-Comm). Hatching eggs used to obtain the parents of the commercial strain were shipped to Logan from midwestern United States. Eggs were hatched and parent stock were reared to maturity under natural Logan conditions. These commercial birds were incross-hybrids and were hatched from eggs produced by this parent stock. Experimental chicks of all three strains were hatched in the same incubator, identified with wing bands, intermingled after hatching, and were then floor-brooded and reared under the same conditions.

At seventeen weeks of age the birds were placed in individual cages in units of five birds each, with eight units per strain arranged randomly inside three different rooms. Temperature regimes in these rooms were  $65 \pm 5$  F; 70-100 F; and natural or "uncontrolled" temperature, representing conditions under commercial production in Logan. The 70-100 F regime fluctuated daily by controlled programming to permit 100 F from

(Continued on page 105)

DR. C. ELMER CLARK, associate professor of poultry husbandry, joined the Station staff a year ago after receiving his Ph.D. degree from the University of Maryland. He came to the University in 1952 as extension poultryman. M. NIKOPOUR was a graduate student in poultry husbandry. DR. C. I. DRAPER is head of the Department.



# THE AIR MASS IN ACTION

G. L. ASHCROFT, LOIS M. COX

E. A. RICHARDSON

**W**HAT makes a storm? Why? How? In part 1 of this series, the basic ingredients of weather were discussed on a global and local scale. In this installment we'll learn more about storms and their occurrence across the geographic belt that includes Utah.

Utah lies in a temperate zone of the globe. The general air circulation across the state, therefore, is from west to east. The state's weather also is affected by the capriciousness of the polar air mass to the north.

No matter where it occurs, the line of contact between contrasting (warm-cold) air masses is called a front. Except in a few cases, fronts (warm, cold, or stationary) lie in low pressure troughs. This accounts for the drop-

ping barometric pressure as a front approaches. In considering storms, it is also important to remember that the most severe forms of weather occur in frontal areas. Winds, clouds, precipitation, and temperature contrasts are greatest where fronts exist.

## *The storm system*

A hypothetical storm system that would have an impact on Utah is shown in an idealized form in fig. 1. When studying the figure, remember that it portrays events that may ac-

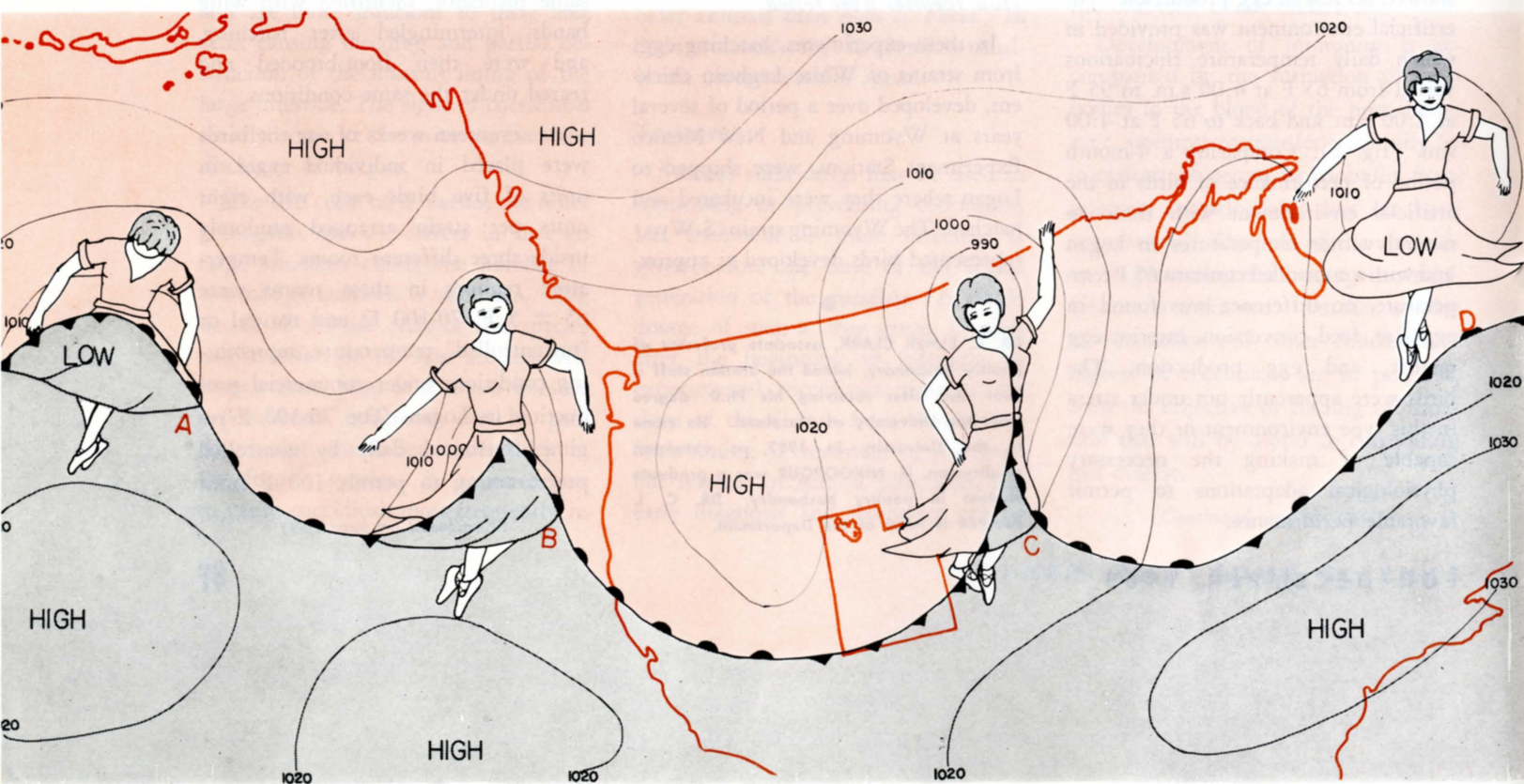
tually be happening simultaneously in various locations around the earth, but it also illustrates the sequential movement of an individual storm from west to east.

In many respects a storm can be compared to a ballet dancer performing a counterclockwise pirouette across the stage, with the stage being a portion of the globe. As the air circulation (the speed of the dancer) increases, the storm intensifies and deepens. As the circulation decreases in speed, the storm dies out or dissipates. Each storm, again like a ballet dancer, has its own unique personality and must be considered in this light. No two storm "ballets" will ever be identical in all characteristics. The generalizations in this article are but descriptions of what usually can be expected to happen.

A few additional background facts must also be borne in mind when interpreting the diagrams. Air always tends to move from areas of high pressure to those of low. In the vicinity of high pressure systems, air moves relatively slowly. Also, cold air will usually move more swiftly than warm

●  
GAYLEN L. ASHCROFT is assistant professor of agronomy, and LOIS M. COX is technical writer for the Division of University Research. E. ARLO RICHARDSON is climatologist of the U. S. Weather Bureau in Salt Lake City.

Fig. 1. Life cycle of an idealized storm system: (A) The storm ballet begins — birth of a frontal wave in the Gulf of Alaska. (B) The tempo increases — storm intensifies decreasing the width of the surface wedge of warm air. (C) The climax — frontal wave occludes in the vicinity of Utah. (D) The finale — storm fades away.







**Cirrus (Ci)**



**Cirrocumulus (Cc)**



**Cirrostratus (Cs)**



**Alto cumulus (Ac)**



**Altostratus (As)**



**Stratus (St)**



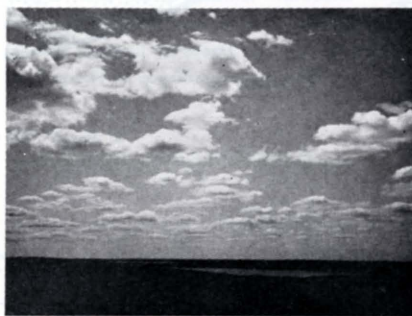
**Stratocumulus (Sc)**



**Nimbostratus (Ns)**



**Cumulonimbus (Cb)**



**Cumulus (Cu)**

air and will push in under the warm air forcing it aloft.

What a meteorologist might describe in many long and complex terms, but we would call a storm area, is shown in fig. 1A. This simply depicts a region where a cold air mass, with its greater speed, is encroaching on a warm air mass. As the storm system develops (fig. 1B), the pressure at the central junction of the two masses gets progressively lower. Eventually the cold air effectively passes under the warm air. This causes the surface junction of the warm and cold air to gradually shift southward.

The cold front is then said to have occluded (caught up with the warm front). The occluding process, or the lifting of the warm air, is graphically shown in fig. 1C. Intense weather ac-

tivity usually is associated with an occluded front.

Once the cold air has displaced the warm air, the two masses undergo more or less general mixing. This process causes the storm to lose its energy, and the occluded front is no more (fig. 1D). The whole procedure, however, is subject to repetition whenever a part of the usually stationary polar front shifts southward.

As a resident of Utah you are affected primarily by cold fronts and occluded fronts. Stationary fronts occur only occasionally over the state, and warm fronts are even more rare. In thinking about moving fronts and how they affect Utah, you should remember that wind near the ground shifts in a clockwise direction in the northern hemisphere as a front passes.

### *Clouds and their messages*

Clouds and storm systems are virtually inseparable. In fact, it is possible to associate certain types of clouds with certain types of weather.

The International Cloud Atlas lists ten main cloud types. The ten can be subdivided into three groups on the basis of their usual altitude.

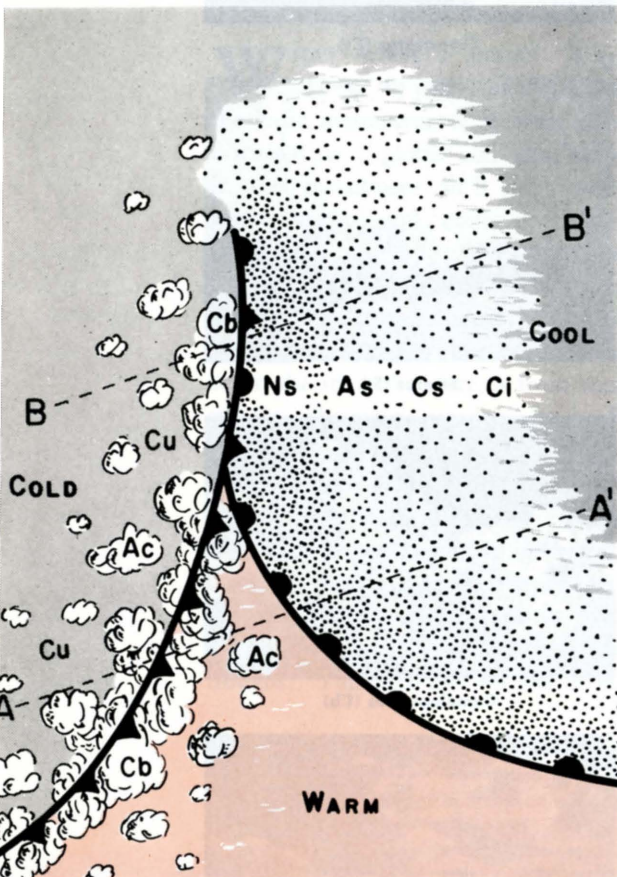
A) High altitude clouds: Usually at



elevations of 16,500 feet or higher, composed almost entirely of ice crystals.

1. Cirrus (Ci): Thin, wispy clouds in the form of delicate

Fig. 2. Aerial view of an idealized cloud pattern associated with an occluding storm



white filaments, small patches, or narrow bands.

2. Cirrocumulus (Cc): Thin white patches, sheets, or layers of clouds without shading. They appear as small individual elements or ripples in a layer. These compose the true mackerel sky.
3. Cirrostratus (Cs): A transparent, whitish veil of fibrous (hair-like) or smooth appearance. They generally produce halo phenomena.

B) Middle altitude clouds: Bases generally at 6,500- to 23,000-foot elevations, composed of water droplets.

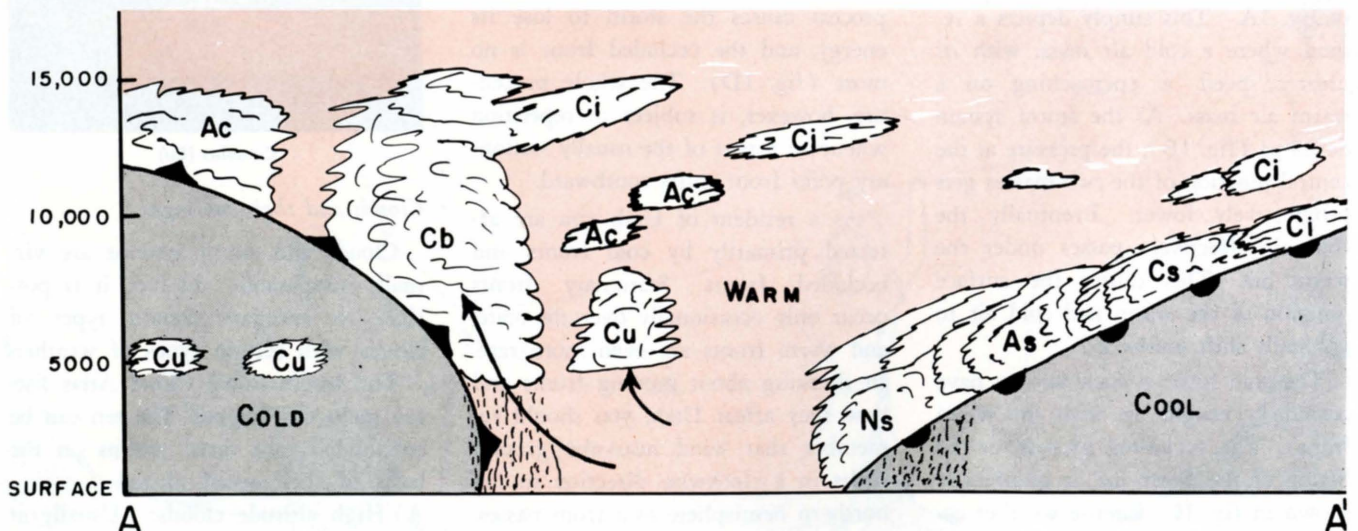
1. Altocumulus (Ac): White or gray patches of layers of puffy roll-like clouds. They resemble cirrocumulus but the puffs or rolls are larger. The sun often produces a corona when shining through altocumulus clouds.
2. Altostratus (As): Dense veils or sheets of gray or blue clouds. They often appear fibrous or lightly striped. Parts are thin enough to reveal the sun as though shining through ground glass. They do not

show halo phenomena.

C) Low altitude clouds: Bases range from surface to 6,500-foot elevations, composed of water droplets.

1. Stratus (St): A low uniform sheet-like fog with base above the ground. These clouds may produce fine drizzle or ice prisms or snow grains.
2. Stratocumulus (Sc): Irregular masses that are gray, or white, or both. Spread out in puffy rolls or layers which may fuse into nimbostratus and produce rain.
3. Nimbostratus (Ns): Gray cloud layer, often dark with diffuse character due to more or less continuously falling rain or snow.
4. Cumulonimbus (Cb): These are the familiar thunderheads. They are heavy dense clouds with considerable vertical development in the form of huge towers. Tops rise to above freezing level and consist of ice crystals, while the lower portions are water droplets.
5. Cumulus (Cu): Puffy, cauliflower-like clouds with continuously changing shapes. Usually form during daytime in

Fig. 3. Cross section through an open wave of a storm along line AA', figure 2





currents of rising warm air then disappear at night. Mean fair weather unless they build up into cumulonimbus.

Getting back to the occluded fronts which we described as common to Utah, let's now consider their idealized cloud sequence. An aerial view of the cloud sequence is shown in fig. 2. Vertical cross sections through the front are shown in figs. 3 and 4. The actual cloudiness of any given front, of course, will vary with the moisture content and stability of air masses.

If everything could be ideally coordinated and you could watch an advancing storm system move to occlusion, you would see the following cloud sequence. Well ahead of the system a few fibrous cirrus clouds would move across the western sky. Within a variable number of hours, depending on the speed of the storm's movement, these cirrus clouds would unite to form a solid sheet of cirrostratus clouds.

This cirrostratus sheet can be seen to become thicker and lower as it advances. Within about 100 miles of the actual surface front, these clouds will be only a few thousand feet above the surface of the ground and are referred to as altostratus. Rain or snow

may begin falling at this point. When precipitation does begin, the clouds will lower rapidly, and you may see some stratus clouds at altitudes of only a few hundred feet. The steady precipitation will continue until the front has passed over the area.

After the passage of the front — the time involved depends on the characteristics of the cold air mass — the precipitation changes to showers. You will then see many "broken" clouds scudding across the sky. Clearing skies will mark the end of the storm system.

#### *Other causes of precipitation*

In the Intermountain Region, frontal activity is not the sole cause of precipitation. The other three sources of our moisture are, in order of importance: upper-level, cold, low pressure centers; warm moist air from the south; and passage of warm moist air up the mountain slopes. The latter is spoken of as orographic precipitation.

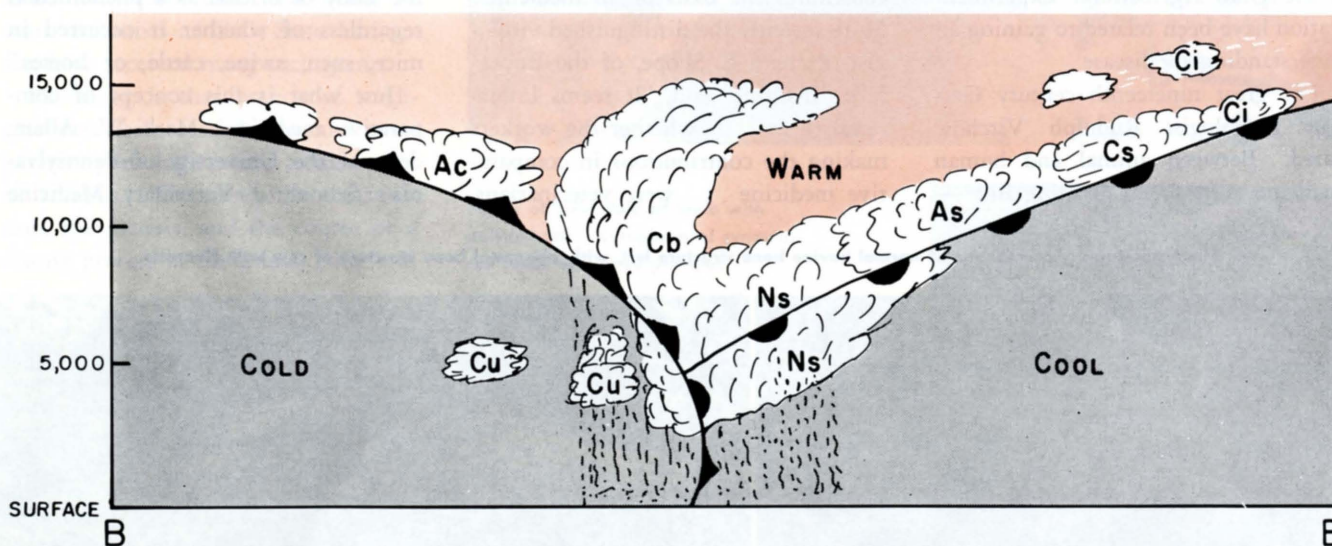
Several times a year during the fall, winter, and spring months, a cutoff, counterclockwise circulation develops over Nevada or Utah. This circulation resembles that shown in fig. 1D, except that the low-pressure center is the only portion of the circulation in

evidence. The characteristics of circulation around a closed low-pressure center aloft produce an upward displacement of lower level air as it is sucked into the center of low pressure. Quite general and heavy precipitation often results, and this phenomenon accounts for a fair percentage of the moisture recorded in Utah during most years.

The movement of warm, moist, air masses will result in isolated thunderstorm activity or orographic precipitation. Thunderstorm activity in Utah is most common during the three summer months, as warm moist air from the Gulf of Mexico flows across Arizona and New Mexico and into Utah and Nevada. Orographic precipitation results when such air moves up the mountain slopes. In general, the orographic effect is superimposed upon the other causes of precipitation in the Intermountain Region. The net result then is that the amount of precipitation obtained from a given storm usually increases as the altitude of the reporting station increases.

The next article of the series will give an insight into how weather forecasts originate. It will also help give an understanding of how general forecasts can be adapted to local needs in specific areas.

Fig. 4. Cross section through an occluded wave of a storm along line BB', figure 2







Left, Dr. John R. Simmons and assistant assaying DNA on a spectrophotometer.

Above, Dr. Ethelwyn Wilcox with her assistants collecting blood for cholesterol assay

## Research in comparative pathology

OVER the past three quarters of a century many research projects at the Utah Agricultural Experiment Station have been related to gaining an understanding of disease.

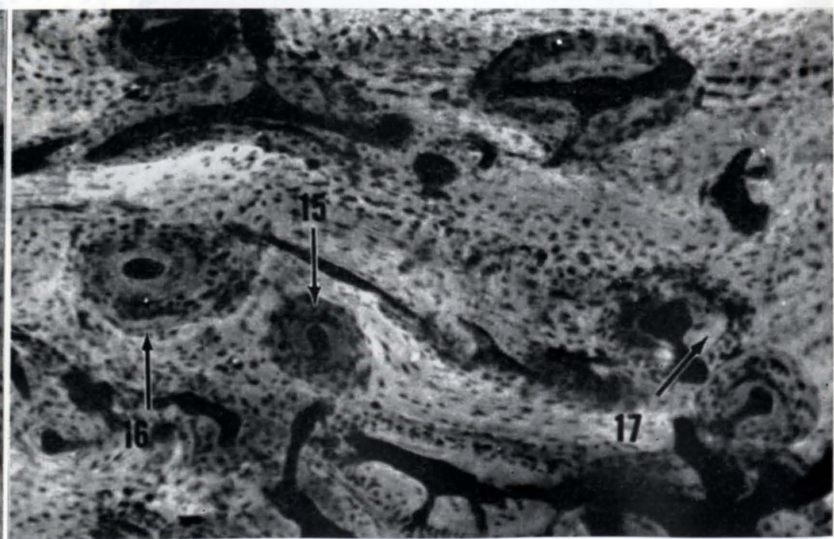
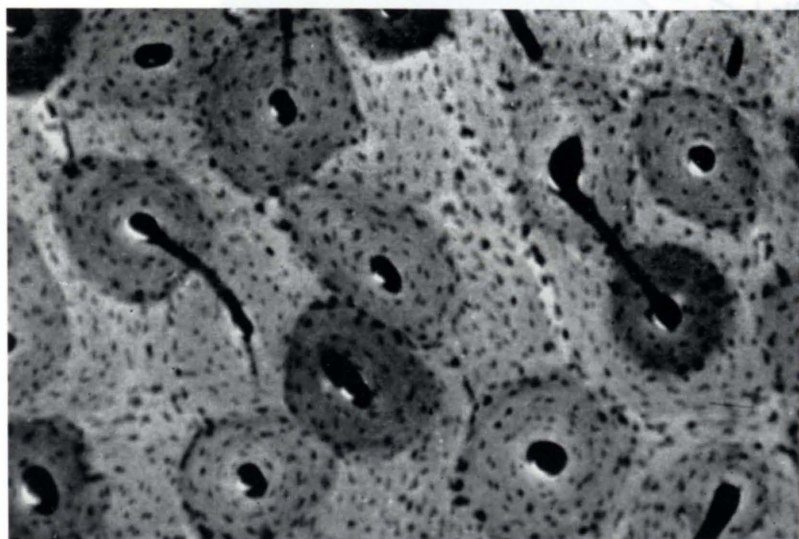
The great nineteenth century German pathologist Rudolph Virchow stated, "Between animal and human medicine there is no dividing line —

nor should there be. The object is different, but the experience obtained constitutes the basis of all medicine." More recently the distinguished virologist, Richard E. Shope, of the Rockefeller Institute, said, "It seems immaterial to me . . . whether the workers making the contributions in comparative medicine . . . were veterinarians,

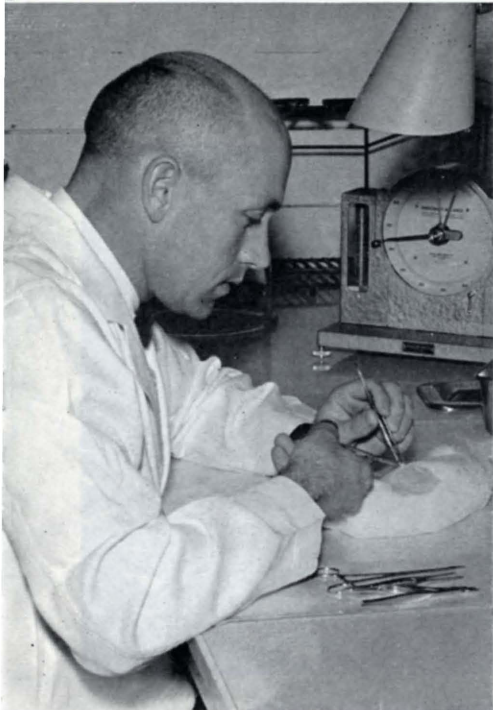
physicians, or chemists; they were all men of science whose interest lay in the study of disease as a phenomenon regardless of whether it occurred in mice, men, swine, cattle, or horses."

Just what is this concept of comparative medicine? Mark W. Allam, dean of the University of Pennsylvania's School of Veterinary Medicine

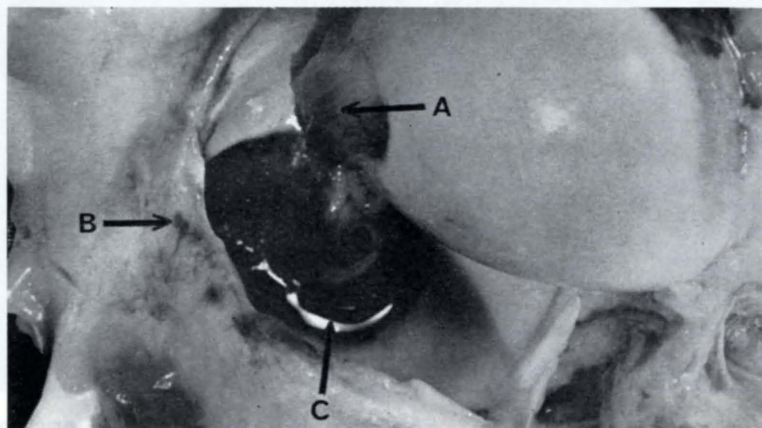
Microradiography comparison of normal bovine bone structure left, with abnormal bone structure of cow with fluorosis







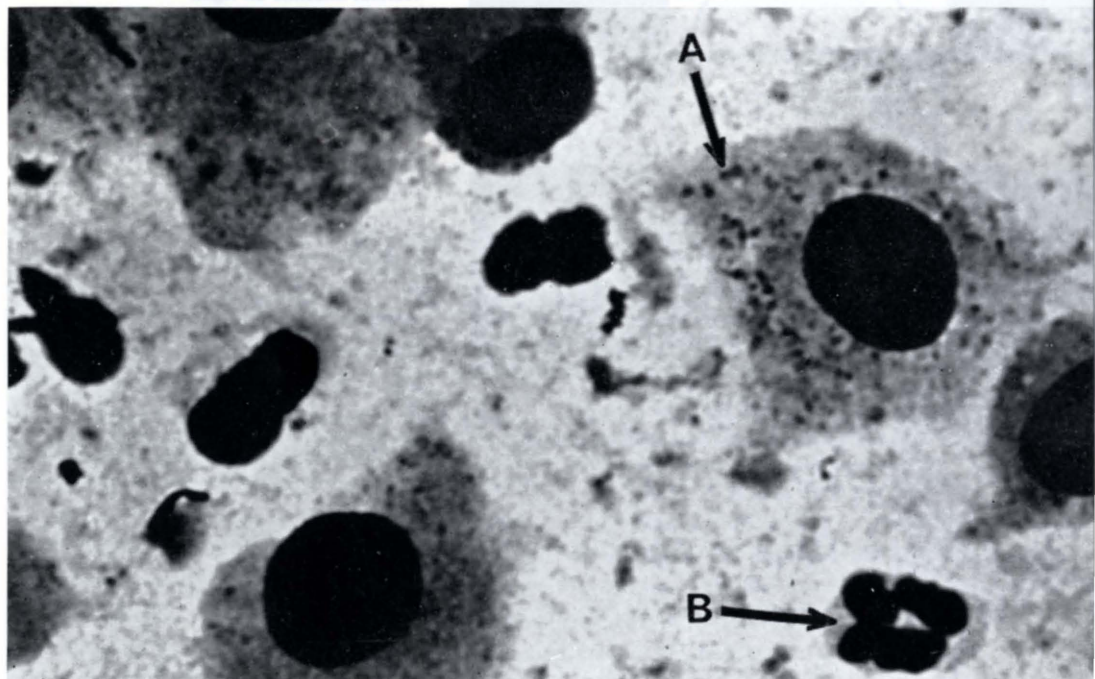
Left, Dr. Warren Foote operating on a guinea pig to detect effects of progesterone on the ovaries. Below, hip joint of a lamb with virus polyarthritis, illustrating tearing of ligament (A) and hemorrhages (B & C)



## MERTHYR L. MINER

writes, "In its simplest terms comparative medicine may be defined as the pooling of knowledge and efforts of individuals trained in special areas of the biomedical sciences. . . ." Even though this concept has been voiced for decades, only in recent years has it been implemented in actual research. The National Institutes of Health have been granting money to any scientist who has a plan that gives promise of unraveling the mysteries of life and disease on the assumption that all knowledge gained will eventually promote the health and well being of man. Scientists at Utah State University have received many such grants.

Pathology is that branch of medicine that deals with disease and comparative pathology relates to disease in all animals. The cause, the transmission, the genesis, and the course of a disease process in the animal body, and



Smear of joint fluid of lamb with polyarthritis. Cytoplasm of synovial cell filled with virus particles

DR. MERTHYR L. MINER is head of the Department of Veterinary Science. This is the last of the centennial articles reviewing some of the research accomplishments and future plans of the Experiment Station in broad subject areas. Previous articles have discussed plant sciences, animal sciences, renewable resources, social sciences, and family life.

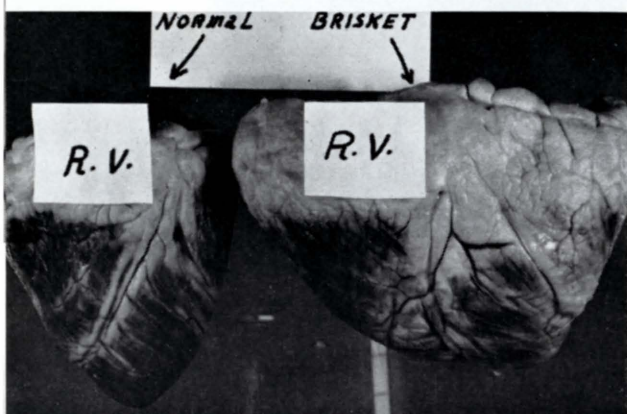


Collecting blood from a turkey by wing-vein puncture for study of effects of staphylococci on turkeys





Illustrating, on the left, the intestinal hemorrhage caused by coccidia in calves. Normal intestine on right.



Two hearts from calves of same age. Right heart has extreme dilation of right ventricle seen in brisket disease. Left heart normal.

the reaction of the body to irritants are some of the aspects of diseases under study. Before a disease process can be understood, the normal structure and function of animal tissues must be studied and understood and much of the current research is in that direction.

Recognizing that many clinical diseases have multiple causes, the research accomplishments of the Station in the area of pathology will be presented in relation to cause.

#### *Genetic effects*

The chemical unit, deoxyribose nucleic acid (DNA), which plays a central role in biological systems, carries

genetic information from generation to generation and directs by chemical code the development and growth of individuals. A derangement of any of these comparatively large and highly complex units will result in abnormal growth and function of a specific tissue or organ. This can result in such diseases as cancer and deformities of limb, heart, and brain. To understand how this occurs, the normal function of DNA must be understood. A cellular physiologist at USU is currently studying a particular DNA of bacteria which directs the synthesis of an enzyme. This enzyme is partly responsible for the metabolism of the sugar, galactose. When this DNA is understood other DNA will be studied to increase our knowledge of growth and development.

A geneticist working with what could be the end result of DNA derangement has after a 15-year study demonstrated in one family the inheritance of multiple tumors through a single dominant gene. The most serious aspect from the standpoint of the family is the development of diffuse intestinal polyps (many footed growths). These predispose to cancer of the colon and rectum. This scien-

tist also has demonstrated the inheritance of abnormal growths in the fruit fly.

An animal geneticist is using white mice to study the causes of increased amounts of cholesterol in the blood. High cholesterol content of the blood has been suspected as a contributory cause to heart and blood vessel malfunction. Preliminary results indicate that heredity is important in regulating serum cholesterol concentration. Future research is aimed at determining the interaction of heredity and various kinds of fat diets in producing high blood cholesterol.

#### *Nutrition and disease*

In the early 1940's a biochemist, a dairy husbandman, and a veterinary pathologist determined that a phosphorus deficiency was one cause of hemoglobinuria (hemoglobin in the urine) in dairy cattle after calving.

A human nutritionist has added to the knowledge about the blood cholesterol problem by studying since 1955 serum cholesterol levels in more than 300 normal school children from the time they were in the third, fourth, or fifth grades through high school.

(Continued on page 108)





# TURKEY SUCCESS STORY

R. H. ANDERSON

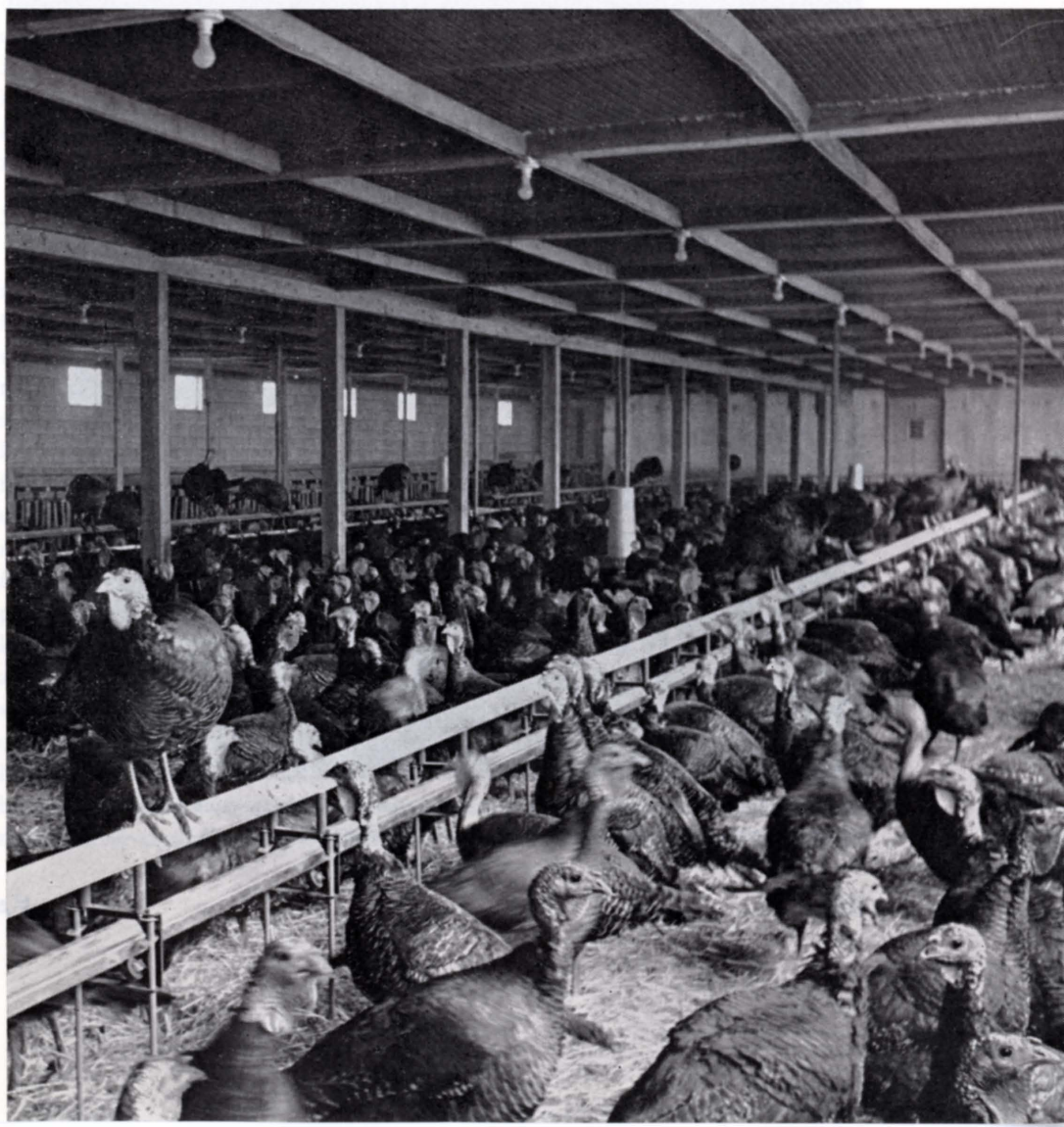
**R**ECENT changes in turkey production costs represent one of the outstanding success stories of American agriculture. Much has been said and written about the efficiency of agriculture in supplying consumers with an abundance of foods of increasing quality at a continually smaller percentage of consumer disposable income. Some food items contribute more than others to this enviable record; turkey is one of these.

From 1954 to 1962 the retail cost of a market basket of food increased about 7 percent. Practically all the increase was due to higher marketing costs since the farm value of these foods except for minor year to year fluctuations was about constant.

*(Continued on page 106)*

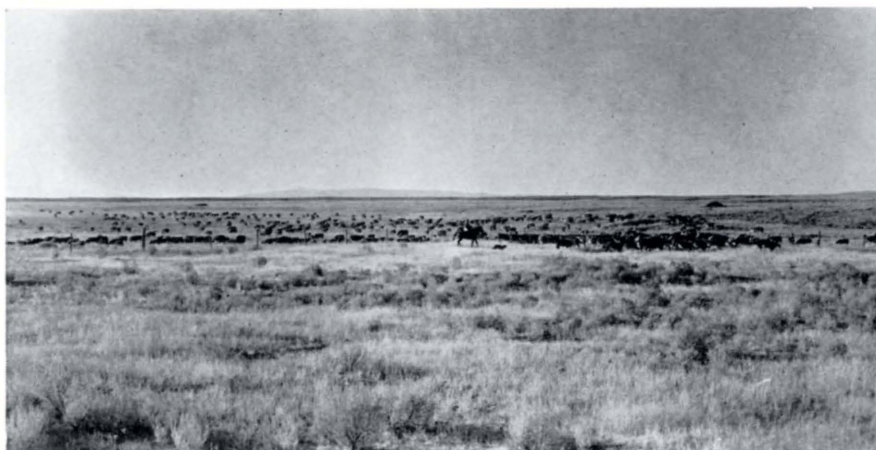
**DR. ROICE H. ANDERSON** is professor of agricultural economics.

Costs of producing turkeys have dropped about 23 percent in 8 years



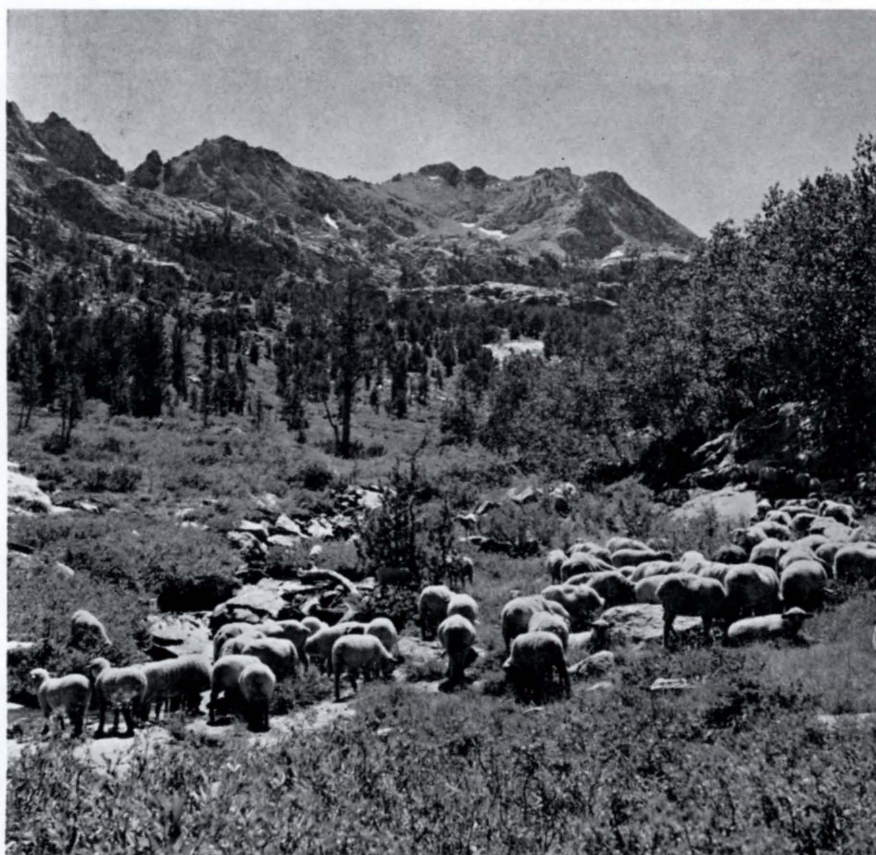
FOR DECEMBER 1963





N. KEITH ROBERTS  
E. BOYD WENNERGREN

# Grazing Fees as Revenue from Federal Grant Lands



Most federal grant lands in Utah, both on the desert and foothill ranges, are used for grazing. Setting equitable fees involves questions of supply and demand.

UPON obtaining statehood Utah received federal grants for the support of schools and other public institutions. The primary objective specified in the Enabling Act was that these grant lands should produce the maximum monetary income over the long run to support the recipient institutions. Of course, this implies the maintenance of a high level of productivity on these lands. Because of the revenue-producing goals attached to grant land management by the Enabling Act, these lands cannot be treated as public lands in the same sense that federal lands are public lands. Federal public land management must rightly be concerned with nonmonetary benefits to society.

This is the fourth in a series of reports concerned with the problems of managing and administering grant lands in Utah. For statistics and background information related to this report, see the articles included in the March, June, and September issues of *Farm and Home Science* for 1963. The authors are members of the Department of Agricultural Economics and have made these studies at the request of the Utah State Land Board.



Grant lands must produce revenue in terms of dollars and cents. Any deviation from prescribed revenue-producing goals is felt primarily by the schools in loss of supporting funds.

From those grant lands still unsold, returns are in the form of fees and royalties. This report deals primarily with fees associated with grazing use.

The Utah State Land Board will be in the land management business for some time to come, and much of the surface use of grant land resources will be devoted to livestock grazing as a single use or one of a combination of uses. Of course, specialized areas may be converted to other uses, but a preponderance of the land will be used for grazing from which the Board will obtain lease fees. To be fair to ranchers, grazing fees for grant lands should not exceed the supply and demand conditions existing in given localities. On the other hand, to satisfy the revenue-producing goal of the Board, fees should not be below that level prescribed by supply and demand conditions. Therefore, the problem is how to make a satisfactory estimate of demand and supply for the forage produced on grant lands.

#### *Grazing fees on grant lands*

Though grazing fees have made up a smaller and smaller percentage of the total returns from grant lands during the past several years, they are still an important source of revenue to the Board (\$122,000 in 1962). The average grazing fee for grant lands in 1960 was 4.7 cents per acre. Little correlation existed between 1960 fee levels and carrying capacity which was used as an estimate of range quality. This lack of a relationship suggests a need for studying the fee-setting mechanism. In the past fees have been established mostly by custom and independent arbitration.

Fees set by formula have an advantage over those set by independent negotiation. First, a logical relation is

established among lessees' fees based upon standards built into the formula. Second, a formula helps remove the question of partiality sometimes charged against fee-setting agencies. Third, fees may be tied in a consistent manner to supply and demand. However, a formula does not remove the responsibility for accuracy on the part of the appraiser nor does it correct for any inadequate data upon which it is based. It should be considered as only an instrument to aid in setting fees more objectively.

Several fee setting formulas have been suggested which reflect differences in range quality and local conditions of supply and demand. Three general formulas are discussed here. They are derived from the value of probable substitutes for range forage available to ranchers. Some data necessary to satisfy the formulas are available; however, some are not. Data not now available need to be developed through study. The general formulas apply to practically all situations. However, the examples are primarily illustrations to show how the formulas might work given complete data for a locality.

#### *Substitute-feed formula*

The concept underlying this fee setting system is that the value of range forage used for grazing is equal to the value of the nearest substitute feed required to produce comparable livestock products turned off the range. However adjustments must be made for differences in costs between methods of feeding. It may take twice as much range forage as the substitute feed to produce a given livestock output. This does not matter. The market price of the nearest substitute feed available to do the same job sets the *maximum value* on whatever quantity of range forage it takes to produce the livestock products. Any feed or combination of feeds that does not have the nutritive capability to produce the

comparable livestock products obtainable from a particular range cannot be considered a substitute for that range forage.

This system sets the fee per AUM (animal unit month: The forage consumed by one cow for one month). (*F*) equal to a measure of energy required in the substitute feed to produce the monthly gain plus maintenance realized from the range (*R*) divided by the energy composition of the substitute feed (*T*) all multiplied by the price per pound of the substitute feed (*P*) plus the difference in the non-feed use costs per AUM for using range vs. the substitute feed (*L*). *L* includes cost differences due to labor, transportation, death loss, and other differential costs.

Symbolically:

$$F = \left( \frac{R}{T} P \right) + L \quad (1)$$

The division of *R* by *T* converts energy to pounds per AUM which when multiplied by *P* converts pounds to dollars. If it is desirable to quote the fees on an acre basis, this can be done by dividing the fee per AUM by the appropriate carrying capacity.

Formula 1 is a sensitive formula in that the price of the substitute feed (*P*) and the differential non-feed costs (*L*) are determined in the market and change whenever feed and other factor and livestock prices change. It is a useful formula if there is a substitute available for range forage which is priced near the range forage level. If the substitute feed costs ranchers a great deal more than range forage, it may be impractical for setting values and fees on rangelands because no one could afford the substitute. However, in most range areas, other forage substitutes are available which can be used to set the *upper limit* on grazing fees.

An hypothetical example will illustrate how this formula works. The example has to be hypothetical because data for each locality will be differ-



ent. Developing data for each case where fees are in question is the responsibility of those engaged in administering the details of grant lands in the state. But, suppose that a seasonal range unit in Utah produces animal weight and maintenance requiring the equivalent of 300 pounds of total digestible nutrients (TDN) per month in the form of grass hay. (Any other measure of energy could be used if conversion techniques are available.) Suppose also during the season that grass hay is the cheapest substitute and is priced at \$16 per ton with an average TDN content of 45 percent. Also, assume that it costs \$1.50 per AUM more to graze state ranges than it does to use the substitute feed. Then;

$$R = 300 \text{ pounds}$$

$$P = \$0.08 \text{ per pound}$$

$$T = 45 \text{ percent}$$

$$L = \$1.50 \text{ (includes differences due to labor, transportation, death loss, and other differential costs)}$$

Substituting these data into formula 1:

$$F = \left( \frac{300}{.45} \$0.08 \right) - \$1.50 = \$3.83$$

If the carrying capacity were the average for Bureau of Land Management (BLM) ranges in Utah which was about 10 acres per AUM in 1960, then the fee per acre ( $F'$ ) is:

$$F' = \frac{\$3.83}{10} = \$0.38 \text{ per acre}$$

The energy composition ( $T$ ) for many substitute feeds or combinations of feeds can be calculated from existing tables prepared by animal nutritionists. Tables giving most likely estimates of livestock TDN requirements ( $R$ ) are available from the same sources. Weight gains necessary to compute  $R$  can be estimated from research conducted on various types of seasonal range and supplemented by observation and experience of ranchers and range appraisers in specific localities. The difference in non-feed use costs between range forage and substitute feed sources ( $L$ ) can be deter-

mined by comparing the two types of operations in a given locality. Research needs to be designed to measure the difference in such costs as labor, death loss, transportation, water, buildings and equipment, and interest on operating costs.

#### *Private lease fee formula*

The private lease fee system is a variation of the substitute feed system. The substitute for range forage produced on grant lands may not be "hand" feeding but may be private ranges or pastures leased for grazing.

Starting from this basis the fee per AUM ( $F$ ) would be equal to the private lease fee per AUM ( $F_1$ ) plus the costs per AUM of services included in the private fee but not provided on state ranges ( $L$ ).

Symbolically:

$$F = F_1 + L \quad (2)$$

$L$  is the most uncertain component in formula 2 and can only be approximated at this time. However, research can determine ways of measuring it.  $L$  is the difference to the lessee between the cost of services provided on private range but not on state ranges and reflects the change in revenue as a result of grazing the private range. Both  $F_1$  and  $L$  are values determined in the market and reflect the market situation for private range in an area.

A survey of private lease fees in the central areas of Utah in 1962 indicated that they ranged from about \$1.50 to as high as \$5.50 per AUM. The most frequent fee for private pastureland was between \$3.00 and \$3.50 per AUM. The level of the fee, of course, depends upon the location and quality of the range, or in other words, the supply and demand situation associated with the particular range available for leasing.

As an illustration of how state land fees might be determined from the use of formula 2, suppose that  $F_1$ , the private lease fee, is \$3.00 per AUM and that services provided by the land-

lord but not by the state amounted to about \$1.50 per AUM. If these figures are substituted into formula 2 and divided by the carrying capacity, we have:

$$F' = \frac{\$1.50}{10} = \$0.15 \text{ per acre.}$$

A fee calculated on this basis will undoubtedly always be lower than one calculated on the basis of formula 1 because privately owned pasture is a cheaper substitute than purchased feed as was assumed to illustrate formula 1.

#### *Permit value and fee formula*

In formulas 1 and 2 grass hay and privately owned pasture were considered the substitute feeds for state range forage. If instead of these feed sources the nearest substitute feed for a given range situation is purchasing similar Bureau of Land Management (BLM) permits, formula 3 can be used to estimate grazing fees. The fee per AUM ( $F$ ) is equal to the discounted ( $C$ ) permit sales value ( $S$ ) plus the current BLM grazing fee per AUM ( $B$ ).

$$F = SC + B \quad (3)$$

Because BLM objectives have not been to maximize returns from grazing lands but have been to meet range management and improvement costs, BLM grazing fees are lower than if profit were the goal. However, buying BLM permits and paying the current public range grazing fee is a real alternative for a rancher with established permit eligibility if he wants to substitute BLM range for state range or if he wants to expand operations. Hence, it is an alternative for establishing a fee on state lands which are similar in quality to BLM rangelands.

A survey of ranchers and financial agencies in Utah made in 1960 revealed that BLM permits sold for about \$10 per AUM. These figures were surprisingly consistent for bona-fide sales throughout the state.

An example of how formula 3 works follows: Suppose that BLM



permits sold for \$10 per AUM and the fee was \$.30 per AUM, which is the 1963 fee (B) and that the discount rate (C) was 5 percent. Then substituting these data into formula 3 gives,

$$F = (\$10 \times .05) + \$.30 = \$.80 \text{ per AUM.}$$

Now if the carrying capacity is 10 acres per AUM, then the fee per acre (F') is:

$$F' = \frac{\$.80}{10} = \$.08 \text{ per acre}$$

Obviously, a fee based on formula 3 would be lower than one based on either formula 1 or 2 because the substitute feed which is assumed to be BLM permits is cheaper than either grass hay or forage produced on private pastures.

The Land Board could not possibly charge a fee higher than the one based upon the logical substitute feed available in a given area. If it did so, ranchers would not lease state lands and would resort to the purchase of the substitute feed whether in the form of harvested feed or substitute grazing situations. On the other hand, the Board's goal is to maximize monetary returns from the grant lands under its jurisdiction. Therefore, fees should at least reflect the competitive position of state grazing lands in relation to the nearest substitute feed source in a given locality.

## GROUP FEEDING

(Continued from page 87)

the difference among treatments (table 1), although the individually fed cows produced slightly more than the other two groups. Body weight change favored the individual feeding with the group fed twice daily next.

### More detailed trial confirms results

In the second trial, during three 28-day periods, cows were fed in three groups, the same as in the first trial, except that some of the cows were kept on the same treatment through-

Table 1. Response of cows to individual and group feeding of grain — preliminary trial

Method	(1) Individual	(2) Group	(3) Group
Frequency .....	twice daily	twice daily	once daily
<b>Daily production</b>			
Milk, pounds .....	46.2	45.8	45.4
Milk, fat, pounds .....	1.76	1.67	1.71
4% fat corrected milk, pounds.....	44.9	43.4	43.8
<b>Daily feed consumed</b>			
Hay .....	18.9	21.8	20.9
Corn silage .....	31.5	32.1	32.8
Grain .....	9.8	9.8	10.3
Body weight change, pounds.....	+1	-3	-17

Table 2. Performance of cows on different systems of grain feeding on continuous and reversal trials

Method	(1) Individual	(2) Group	(3) Group
Frequency of feeding.....	twice daily	twice daily	once daily
Daily hay consumed, pounds .....	22.5	21.1	22.1
Daily silage consumed, pounds .....	31.2	31.0	30.6
Daily grain consumed, pounds .....	7.9	7.6	7.6
Total body weight change, pounds (continuous).....	+58	+40	+51
Daily milk (FCM) produced, pounds.....(continuous)	33.2	34.5	29.9
.....(alternate)	31.1	31.7	29.9
Daily decline in milk (FCM) from preliminary period to third period, pounds .....	7.3	4.9	6.4
Daily decrease in milk (FCM) when changing from other two treatments, pounds.....(reversal)	0.9	1.8	3.2

out the trial while others were rotated during the three periods of the test.

In these trials 36 cows were grouped by threes on the basis of production, stage of lactation, and body weights. Feed consisted of high quality alfalfa hay, grain mix, and corn silage. In addition, iodized salt, dicalcium phosphate, and water were supplied free-choice.

Hay was offered free choice and was kept before the cows at all times. Grain was fed according to production, allowing one pound daily for each pound of butterfat produced weekly. Adjustments for grain were made every two weeks. Where grain was fed in groups, the total amount for all cows in the group was weighed and spread evenly along the silage manger. The manger was sufficiently long for all cows to eat at one time, giving each cow equal opportunity to obtain her share. The third group received grain following the morning milking.

Grain was given to the second group after each milking, while cows fed individually received grain twice daily during the milking operation.

Corn silage was group fed to all cows according to body weight, allowing 2½ pounds of silage for each 100 pounds of body weight. To limit any variation due to silage consumption the amount to be fed was calculated from average body weights at the start of the trial and remained constant throughout the trial.

Cows on all three treatments were maintained in a hard surfaced corral and open shed housing. Hay mangers were at the end of the corral with a silage manger along one side.

Records were kept of all feed weights, including hay, grain, and corn silage. Any feed left at the end of a period was weighed back and deducted from the total amount fed. Milk production for each cow was weighed at each milking and milk fat tests were run twice monthly. Four



percent fat-corrected-milk (FCM) was computed to correct to a common base milk of varied fat tests.

Feed consumption and body weight changes did not differ appreciably during the trial (table 2).

Total milk production of the second group fed grain twice daily was 2296 pounds of FCM more than that produced by the third group fed grain once daily. Decline in milk production from the preliminary period to the third period was least for the second group and most for the individual feeding.

Daily FCM production in the reversal phase of the trial, where cows at the end of each 28 day period were changed to another treatment, was similar for each group. Decline in production when changed from one treatment to another was least for the individually fed animals and greatest for the cows fed grain once a day. None of the differences in either phase of the trial were sufficiently great enough to be statistically significant.

#### *Concerns in group feeding*

The greatest concern in group feeding of cows may be for the higher producing cows which need more grain but may not be able to get it. Such a problem was not observed in this trial based on milk production, body weight change, or general health and appearance of the cows. Both Jersey and Holstein cows were included in the trial with no apparent differences in response to treatment.

Under group feeding of grain, it is important that the total amount to be fed be based on the production of each cow in the group. Disregarding this principle of management will result in lower production. Where cows are corralled by groups, there may be merit in grouping them according to production level, although there has been no evidence in the trials reported here nor in the herd since that time which

indicates any special need for such a grouping. Grouping of younger cows, and particularly first calf heifers, may be a better basis for grouping. Sufficient manger space should be available for all cows to eat at one time, otherwise the less aggressive cows will be denied their share of grain.

## COCCODIOSIS AND TRICHOMANIASIS

(Continued from page 90)

### TRICHOMONADS

Trichomonads are also protozoa, but of a different class, characterized by having flagella. They are parasites of the alimentary or genitourinary systems of numerous vertebrate and invertebrate hosts, including man. In women they cause vaginitis characterized by a persistent discharge. The same species also invades the male urethra and prostate. The trichomonad found in the intestine of humans is not pathogenic.

The most important species of trichomonad in cattle is *Tritrichomonas foetus*, which lives in the reproductive system and causes temporary infertility, abortions, or chronic infection of the uterus. This organism is usually transmitted by breeding, and thus its incidence in dairy cattle has decreased as artificial insemination has become more widespread. However, genital trichomoniasis, the disease caused by *T. foetus*, is still of considerable importance in beef cattle in Utah and neighboring states. In a survey of 383 beef bulls in 8 localities in Utah, Idaho, and Colorado in 1954 to 1956, 6 percent had trichomoniasis. It was estimated that the resulting losses in production amounted to about \$800 per infected bull annually.

Genital trichomoniasis is a chronic disease in bulls, where the organism is found in the sheath and on the surface of the penis. The reproductive ability of the bull is not impaired by the infection, except that trichomonads are deposited in the vagina of the female,

Adaptations of the system described will no doubt be found on some farms. Such adaptations can be healthy. As herds increase in size and as competition becomes keener, dairymen must continually strive to find ways such as group feeding of grain by which they can remain competitive.

along with the semen. These trichomonads multiply in the vagina and uterus, resulting, by a process not yet known, in the death of the embryo or fetus. When death occurs during the early weeks of pregnancy, as a rule, no abortion or abnormal discharge is noted. In this case, the heifer or cow is generally thought to have failed to conceive, with a delayed return to estrus, or a missed estrus. When the fetus dies at a later stage of pregnancy (3-4 months) abortion may be observed, the fetus may be retained, or the uterus may become filled with pus. Sometimes, permanent infertility may result from trichomoniasis, although the infection usually disappears spontaneously, and fertility returns after a few months.

The presence of trichomoniasis in a herd may most easily be detected by examination of samples from the bull. These are examined both directly under the microscope, and by making cultures. Infected bulls may be successfully treated by applying a medicated salve to the penis and prepuce while the bull is under the influence of a tranquilizer or of anesthesia of the genital region, or by repeated douching and massaging with a therapeutic solution. Therefore, the disease may be eliminated from a herd by replacing or treating infected bulls, and by carefully following a prescribed breeding management program.

Other species of trichomonads occur in the digestive system of cattle, where they apparently do not cause any trou-



ble. However, some persistent cases of diarrhea have been observed in which numerous trichomonads were present in the feces. These may have been a factor in causing the diarrhea, or may have multiplied as a result of the changed conditions associated with the diarrhea. The most prevalent trichomonad in the bovine digestive tract is one which typically has 5 anterior flagella, and is thus called a pentatrichomonad. The species found in cattle is apparently identical to one (*Pentatrichomonas hominis*) found in man, dogs, cats, and other animals. It occurs commonly both in the rumen and cecum of cattle. No definite proof of pathogenicity has been observed in any of the hosts. Another species of trichomonad found in the rumen and cecum of cattle is similar to one occurring in the cecum of pigs and is probably identical with that species. This trichomonad, *Tetratrichomonas buttreyi*, has 3 or 4 flagella and is much smaller than *P. hominis*. A third species, *Monocercomonas ruminantium*, occurs only in the rumen, where its importance is unknown. None of the trichomonad species living in the digestive tract is similar in appearance to *T. foetus*, so that there is little danger of confusing these if the specimens are examined carefully.

## TEMPERATURE AND EGG PRODUCTION

(Continued from page 91)

9:00 a.m. to 6:00 p.m., 70 F from 12:00 midnight to 3:00 a.m., and six hours to make the transition from 70 F to 100 F and from 100 F to 70 F (fig. 2). During this experiment November-March) the mean temperature in the "uncontrolled" room was 42.4 F with a range of 35 to 55 F (fig. 3) (1961-62). The two rooms having controlled temperature were inside a windowless house and here artificial light was from 6 a.m. to 8 p.m. In the uncontrolled room the same arti-

Table 1. The influence of temperature on egg production (hen-day basis) of three strains of White Leghorn — percentage values based upon 65 F = 100 percent.

	New Mexico		Wyoming		Commercial	
	Percent	Egg production	Percent	Egg production	Percent	Egg production
65 F.....	100	.66	100	.79	100	.79
70-100 F.....	96	.64	87	.69	90	.71
Uncontrolled.....	79	.53	95	.75	92	.72

Table 2. Influence of temperature on percentage of egg shell from three strains of White Leghorn — relative percentage values based on 65 F = 100 percent

	New Mexico		Wyoming		Commercial	
	Percent	Percent shell	Percent	Percent shell	Percent	Percent shell
65 F.....	100.0	8.76	100.0	8.99	100.0	8.77
70-100 F.....	96.1	8.42	94.9	8.53	93.1	8.16
Uncontrolled.....	99.7	8.73	98.8	8.85	102.5	8.99

Table 3. Influence of temperature on feed conversion in three strains of White Leghorn — percentage values based upon 65 F = 100 percent

	New Mexico		Wyoming		Commercial	
	Percent	Feed per dozen eggs	Percent	Feed per dozen eggs	Percent	Feed per dozen eggs
65 F.....	100.0	4.59	100.0	3.89	100.0	4.23
70-100 F.....	92.9	4.26	94.4	3.67	92.8	3.92
Uncontrolled.....	129.1	5.92	109.1	4.24	104.7	4.43

ficial light schedule was provided with daylight not excluded. No nutritional variables were included and running water was provided in all rooms *ad libitum*.

Measurements of performance were taken at 28-day intervals and included: body weight, average egg production for each interval (hen-day basis), feed conversion, interior egg quality (Haugh units), eggshell quality, and mortality as it occurred.

The average body weight of all birds was about 0.5 pounds more in a temperature of 65 F than in one varying from 70-100 F. It was apparent also that the Wyoming birds were smaller, less capable of adjusting to warm temperature, and had greater weight increases in coldest temperature than birds of the other two strains.

Temperature-strain relations for egg production are illustrated in table 1. Egg production was from 4 to 21 percent higher at 65 F than at the other temperatures. Considering all strains together, it appeared that for egg pro-

duction, the thermal stress was as critical at 70-100 F as at the "uncontrolled" temperature (30-55 F). This was true for the commercial strain. However, a different situation was observed with the S-NM and the S-Wyo birds. The New Mexico strain produced more eggs at 70-100 F than at uncontrolled temperature (30-55 F) with the opposite being true for the Wyoming strain. The data indicated that New Mexico birds were under greater stress at the colder temperature and Wyoming birds at the warmer temperature. This suggests that genetic adaptations for egg production had been previously made to native environments, and that in one generation the birds were incapable of making complete adjustments in a temperature of the opposite extreme.

### Egg quality not affected

Although strain differences were observed in interior egg quality (Haugh units), no strictly environmental or genetic-environment relations were found. The interior egg



quality of newly laid eggs was not influenced by surrounding temperature.

#### *Differences in thickness of shell*

There were definite strain differences in thickness of eggshell and in ratio of shell to egg weight. The Wyoming birds were superior in both of these measurements. As was expected, the shells were markedly thinner when the surrounding temperature of the birds was higher. However, as illustrated in table 2, percent of shell from the New Mexico birds declined less at 70-100 F than the eggshells of the other two strains. Since shell thinness at warm temperatures is the major concern, no particular advantage was suggested by emphasizing superior shells at cool temperatures.

#### *Feed conversion better in warmer weather*

Less feed was required per dozen eggs (table 3) in 65 F and 70-100 F than in the uncontrolled temperature (30-55 F). The lowest (best) feed conversion appeared in 70-100 F for all strains. From this it would seem that high temperatures had a greater influence in decreasing feed consumption than in decreasing egg production.

#### *Relation of data to commercial flocks*

It is interesting to speculate with these data in terms of their relation to commercial laying flock proficiency. Based upon data presented here for the commercial strain and projecting this into a flock of 10,000 commercial layers, and with eggs at \$.35 per dozen, there would be an economic advantage in increased egg production of about \$3000 over a 5-month winter period in favor of the 65 F temperature over the natural temperature. In addition, there would be about 0.2 pounds per dozen improvement in feed conversion in the 65 F temperature, giving an additional \$600 advantage over natural conditions. It should be re-

remembered that data presented here were obtained during a relatively severe winter (fig. 3) 1961-62 and with no attempt at maintaining any temperature control. During the same period the following winter (fig. 3), 1962-63, a much different situation occurred. This was a relatively mild winter and the birds appeared to be under less stress from cold temperature. Egg production for the commercial birds under these milder conditions was about 14 percent higher than at  $65 \pm 5$  F. From this it seems that 65 F is not necessarily the optimum laying flock temperature. Investigations by the United States Department of Agriculture have found that chickens will produce more eggs at 55 F than at 85, 40, or 70 F. Their results showed that 40 F and 70 F were comparable for egg production. This tends to corroborate the data referred to here for the 1962-63 winter, and suggests that a temperature between 45 F and

55 F is most stimulating to laying hens.

Severe summer temperatures, simulated in this experiment (70-100 F) are equally depressing to laying hens and to laying flock economy. A speculative example, again on 10,000 hens, would show that for a 5-month period under these conditions about \$3500 would be gained from increased eggs by providing surrounding temperatures of about 65 F.

Evidence presented indicates that extremely high or low temperatures are not conducive for full reproductive capacity of chickens. It has also been shown that strain variations in ability to withstand extreme temperatures exist. Since higher relative rates of production were observed at 70-100 F and at 30-50 F from birds originating in warm and cool environments, respectively, it seems feasible to develop special strains for environments where temperature hazards exist.

## **COSTS OF PRODUCING TURKEYS**

(Continued from page 99)

#### *Changes in cost of turkey production*

The cost of producing turkeys in Utah during the 1954-62 period decreased about 23 percent, from 32.9 to 25.4 cents per pound. These facts are based on comparable studies of costs and returns for 35 Sanpete County turkey flocks in 1954 and 50 in 1962.

All cost items decreased from 1954 to 1962 with variations from 31.8 percent for labor to 14.3 percent for

"other" costs (table 1). Increased labor efficiency resulted partly from additional capital investments in labor-saving devices, which could account for some of the difference in change in these two categories of cost. The change from temporary to permanent fencing for enclosing turkeys is an example of substituting capital for labor. The "all other" category increased slightly as a percent of total costs. Poult and labor costs decreased rela-

Table 1. Cost of producing turkeys — Sanpete County, Utah, 1954 and 1962

Cost item	Cost per pound, oven ready		Percent of total		Change 1954-1962
	1954	1962	1954	1962	
	cents per pound		percent		percent
Feed .....	21.7	16.2	66.0	66.1	-22.6
Poult .....	5.5	4.0	16.7	16.2	-25.5
Labor .....	2.2	1.5	6.7	5.9	-31.8
All other .....	3.5	3.0	10.6	11.8	-14.3
Total .....	32.9	24.7	100.0	100.0	-22.8



tively and feed remained proportionately unchanged during the period.

#### *Physical vs economic changes*

Did cost of turkey production decrease from 1954 to 1962 as a result of increased efficiency or because of decreased prices of the input factors? To answer this question a comparison was made of changes in the physical and economic inputs (table 2). Physical quantities per pound of turkey for all factors decreased from 1954 to 1962 indicating increased efficiency. Hours of labor per pound of turkey exhibited the greatest rate change, 43.6 percent, and number of poult the least, 10.0 percent.

Measured on the basis of price change of the input factors, feed and poult costs decreased while labor and "other costs" increased. Wage rates were up from \$1.00 to \$1.21 per hour from 1954 to 1962. Price and quantity distinction of "other costs" is based on buildings and equipment investment per turkey started, a major item in this category.

Some problems should be recognized in attempting to separate the physical and economic changes in these inputs. For example, while prices of feed per hundredweight declined only 10.6 percent, the composition of the feed for the two years was not identical. The 1954 ration was comprised of 61 percent mash as compared with 81 percent in 1962. Had the feed composition been identical the price decline from 1954 to 1962 would have been greater. Also, the lower price of day-old poult in 1962 undoubtedly reflects increased efficiency in the hatching and breeding phase of the industry resulting from improvements in fertility and hatchability of turkey eggs. The separation of physical and economic change shown in this study pertains only to the farm production phase of the industry.

### COMPARISON OF 1954 AND 1962 TURKEY PRICES

**1** Technological improvements in turkey breeding, feeding, and management have resulted in about 23 percent reduction in cost of production in 8 years. While some of the reductions in cost were due to lower prices of inputs, prices of some inputs actually increased during the period. The decreased costs resulted primarily from increased physical efficiency.

**2** As the cost of production went down, volume of production increased. The resulting reduction in prices is a major reason for the rapid increase in per capital consumption of turkey in the United States.

**3** Changes in production efficiency in relatively short periods of time emphasizes the merits of an agricultural economy which permits rapid adjustment to these changes.

Table 2. Physical and economic input factors used in turkey production and changes from 1954 to 1962 — Sanpete County, Utah

	Unit	1954	1962	Change 1954-1962
<b>Physical measurement:</b>		quantity per lb. turkey, oven ready		percent
Feed.....	pounds	5.500	4.700	-14.5
Poult.....	number	0.070	.063	-10.0
Labor.....	hours	0.022	.015	-43.6
All other.....				-32.7*
<b>Economic measurement:</b>		prices per unit		
Feed.....	dollars/cwt.	3.98	3.60	-10.6
Poult.....	cents/each	78.00	65.00	-16.7
Labor.....	dollars/hour	1.00	1.21	+21.0
All other.....				+27.7*

\*Based on change in one major item in this category, investment in buildings and equipment, which decreased from \$1.04 to \$.70 per turkey started.

Table 3. Selected ratios in turkey production and changes from 1954-1962 — Sanpete County, Utah

Item	1954	1962	Percent change 1954-1962
Death loss, percent of number started.....	11.0	14.8	+13.4
Percent of death loss in brooding period.....	44.4	44.5	+ 0.02
Mash as a percent of total feed.....	60.9	81.0	+33.0
Percent of salable turkeys Grade A.....	92.5	71.6	-22.6
Market weight of hens.....	12.3	12.3	0.0
Market weight of toms.....	22.7	25.6	+12.8
Production period for hens, days.....	173.0	149.0	-13.9
Production period for toms, days.....	202.0	193.0	- 4.5
Gain per day for hens, pounds.....	.070	.082	+17.1
Gain per day for toms, pounds.....	.113	.132	+16.8



### *Other changes in turkey production*

Death loss was 14.8 percent in 1962 compared with 11.0 percent in 1954. This increase was probably a year to year fluctuation rather than indication of a trend (table 3). A similar sample of flocks in Sanpete County for 1961 had an average death loss of 12 percent. The percentage of total loss during the brooding period was identical for 1954 and 1962.

The increase of 33 percent in percentage of mash in the ration in 1961 as compared with 1954 is significant and is one factor responsible for the improvement in feeding efficiency.

Number of turkeys in top grade declined more than 20 percent from 1954 to 1962 and suggests a reliable trend based on other evidence. Tur-

key flocks in northern Utah were graded about 10 percent lower in 1962 than in 1954. Percent of turkeys grading A in 36 Sanpete flocks in 1961 averaged below the 1954 level. Either grade standards have been increased over time or deformities and other factors causing turkeys to be down graded are more prevalent in recent years. These data do not determine which.

The other ratios shown in table 3 are somewhat related to each other. Hens were reared to the same weight in 1962 as in 1954 in 14 percent less time for a 17 percent increase in gain per head per day. Toms were reared to 12.8 percent greater weight in 4.5 percent less time for a growth gain of about 17 percent from 1954 to 1962.

## COMPARATIVE PATHOLOGY

(Continued from page 98)

This and short-time studies with college students have given a basis for a delimiting normal range of cholesterol levels. These researchers have revealed that fats rich in linoleic acid (corn and cottonseed oils) lowered serum cholesterol levels while animal fats did not. They found the change was dependent on initial serum level and diet content of cholesterol. They demonstrated that varying levels of milk and protein consumption did not affect serum cholesterol and lipid (fats insoluble in water) levels. Work on lipid metabolism and the relation of steroid hormones to lipid metabolism in human subjects is continuing.

This nutritionist also showed that a hemorrhagic proliferative inflammation of the gums called gingivitis in Navajo Indian children entering the Intermountain Indian school was the result of vitamin-C deficiency. She also demonstrated that girls with a history of rheumatic fever had significantly poorer diets than girls with no evidence of rheumatic fever. She found that teenage girls had lower levels of nutrition than boys of the same

age. This condition threatens their health during the later child bearing period.

Nutrition studies are concerned with not only the food consumed by man or animal but also with the transport of nutrients from the digestive system to the ultimate cell for use. Cells are bathed in fluids which contain, along with other nutrients, minerals in ionic solution. In certain diseases there is an imbalance of these electrolytes. Using a yeast, a physiologist is studying the role of enzymes through several pathways in ionic transport between cells and their bathing fluids.

Protein deficiency in man and animal is an important nutritional problem in many of the undeveloped countries. Such deficiencies result in poor growth; poor feathers, fur, or hair; low resistance to infectious diseases, and other disorders. A poultry nutritionist is studying amino acids, the building units of protein, in chicken and turkey nutrition not to overcome a protein deficiency but to determine how to produce a pound of

chicken from a pound of feed. He has demonstrated that for optimum growth and health the right kinds of amino acids in the right proportions are essential. Diets with the amino acids out of balance cause just as severe pathologic changes as those which lack protein.

On our winter ranges water is sometimes scarce and the temperature cold. An animal nutritionist is studying the effects of water deprivation and cold temperature stress on animal performance.

### *Poisons cause disease*

Closely related to nutrition studies is the investigation of the effect of toxic substances on the body. These may be present in the food as an excess of a normal substance or as a substance foreign to the normal diet. A new and challenging finding by a veterinary pathologist was that a chemical substance in certain range plants eaten during gestation would so alter the developing embryo that definite malformations would be present in the new born. *Veratrum californicum*, commonly known as false hellebore or skunk cabbage, a range plant, when eaten by ewes pregnant between 10 and 15 days causes a cyclopic type of malformation. It is also suspected that a toxic plant produces so-called "crooked calf disease," (deformed legs and spine and sometimes cleft palate) when eaten by the cow at the right stage of gestation. These findings are leading to basic studies of what happens to the chromosome or DNA so that development of certain organs is changed or arrested.

Several workers in nutrition and pathology have studied the effects of oxalates, the toxic principle in halogeton, an abundant poisonous desert range plant.

Industrial development, atomic explosions, automobiles, and the use of agricultural chemicals have resulted in pollution of air, water, and food. The



effect on animals of such pollutants has been studied. Sheep in southern Utah were examined in the early 1950's for effects of radiation from fallout. More recently the carry-over of radioactive iodine and strontium from hay and pasture into the milk of cows was evaluated.

Fluorides in aluminum, phosphorus, and iron ores are given off into the air during processing resulting in fluorine contamination of forage. A 12-year study of fluorosis, begun in 1951, has culminated in the delineation of the effects of fluorides on dairy cows. The teeth and bones are primarily affected and the clinical symptoms of physiological responses and structural changes have been associated and correlated with time and amount of fluorine consumed.

In the study of fluorosis of cattle, lameness was one sign of the disease. In the course of making differential diagnosis of the lameness of cattle a veterinary pathologist delineated a degenerative arthritis. The disease in cattle was shown to have characteristics in common with a similar disease in man.

Fluorine, detergents, and radium are modern day water pollutants. Fishery biologists have determined their effects on trout. Fluorides kill trout in relatively low concentrations and environmental factors such as water temperature, water hardness, chloride concentration, and age and size of fish influence which concentration is most active. Detergents in low concentrations kill trout by damaging the gills and stopping breathing. Radium is accumulated by fish in alarming proportions. Further studies on effects of radioactive materials are in progress.

Soon after World War II work on the effects of insecticides in animals was begun and is still in progress. Standards and safe levels of intake of most of the common chlorinated hydrocarbons and organic phosphate in-

secticides have been determined. Biochemists and pathologists have demonstrated that although adult ewes may consume various levels of dieldrin and appear normal, toxic amounts of the insecticide may be eliminated in the milk and be detrimental to nursing lambs.

#### *Failures in reproduction*

One of the largely unsolved problems of efficient animal production is reproductive failure. Four researchers, physiologists in animal and poultry husbandry and veterinary medicine, are attacking the problems from different approaches. One study with chickens involves the interaction of nervous functions and hormone control of reproductive processes by the hypothalamus and pituitary glands. Another has to do with the influence of the hormones, progesterone and estradiol, on estrus, ovulation, and fertilization rate in the ewe. Research is in progress on the changes in certain enzyme and enzymatic products in the female reproductive tract under the influence of gonad stimulating hormones. In cattle the cause of early embryonic death within the first month is not known in all cases. One study is aimed at developing a method of diagnosing such deaths.

Infectious agents of disease have been investigated. In the reaction of a host animal to infection sometimes it becomes sensitized. Such hypersensitivity results in an increase of one type of white blood cell, eosinophils, at the place of contact with the infectious agent. A physiologist with ingenious techniques is trying to determine the site of origin of the eosinophils.

#### *Virus diseases*

In the mid 1930's when equine encephalomyelitis was epidemic in horses of the country, an entomologist and a veterinarian demonstrated that mosquitoes were the transmitters of the virus, which causes the disease

from horse to horse.

Of the infectious agents, the viruses are an interesting and challenging group since new ones are being uncovered each year. A veterinary virologist and a veterinary pathologist are intensively studying a group of the larger viruses, the psittacosis-lymphogranuloma group. Recent work has demonstrated that these viruses cause a polyarthritis of lambs and calves. These viruses also cause abortion, pneumonia, and meningoencephalitis of cattle and sheep. Future research will be on the interrelation of these viruses to determine how they cause disease.

#### *Disease caused by bacteria*

One of the most common and longest known bacteria, staphylococcus, causes a severe infection in turkeys with high economic losses. Bacteriologists have been studying the chemical makeup of these bacteria in order to develop methods of identifying strains and to produce an effective vaccine. Phage-typing and sero-typing are also being used in an attempt to determine the relation of staphylococci from turkeys to those found associated with other animals and man. A veterinary microbiologist is investigating the reaction of the turkey to staphylococcal infection with special emphasis on the mechanism by which the organism causes infection. Researchers have developed methods of antibiotic (novobiocin) treatment.

At the request of the National Woolgrowers Association, a study of abortions in ewes caused by a bacterium called *Vibrio fetus* was initiated in 1953. Veterinary pathologists working with colleagues in the other western states have developed an effective vaccine and have worked out the means of transmission of the disease. Ewes have been shown to be carriers and spreaders even though they may give birth to live healthy full-term lambs.



Another regional study is with an extremely small bacterium, commonly called PPLO. This causes a chronic respiratory disease in chickens and turkeys. The veterinarian studying this disease has demonstrated that a concurrent virus respiratory disease (infectious bronchitis) with PPLO infection is more damaging than either disease alone. The proof of enhancing the effect of an infectious disease by another gives a better understanding of field cases which more often than not are of multiple causation.

#### *Animal parasites*

Parasites such as protozoa, insects, and worms also cause common infections of animals which result in considerable economic loss. One of the protozoa, coccidia, produces an intestinal infection in young animals often with fatal results. There are many species of coccidia in calves; the life history of several has been worked out after many years of study. Parasitologists and veterinary pathologists are now studying the immune response of calves in the hope of developing a means of control. They are also evaluating drugs in the treatment of coccidiosis.

Another protozoan, a trichomonad, causes abortion and sterility in cows. Several parasitologists have been perfecting methods of diagnosis and evaluating treatments for these conditions.

#### *Physio-pathology*

One type of cardiovascular failure in cattle results in "brisket disease" which was at one time attributed solely to high altitude. Several years of study by veterinarians has shown that while the low oxygen of high altitudes influences the disease, it is not the sole cause. These studies have shown that cattle have structural peculiarities in the lung that may contribute to the condition. The influence of certain plants in the forage is also being investigated.

## THREE STAFF MEMBERS DIE

**During the past year three staff members died:**

### **F. V. OWEN**

Dr. Forrest Vern Owen, geneticist and head of the Crops Research Laboratory of the U. S. Department of Agriculture on the Utah State University campus, died February 21, 1963. He had been ill for some months.

Dr. Owen received his B. S. degree from Utah State University in 1921, his M. S. from Oregon State University in 1923, and his Ph. D. from the University of Wisconsin in 1926.

He was associate biologist at the Maine Agricultural Experiment Station from 1926 to 1930 when he became a member of the laboratory on sugar beet investigations of the U. S. Department of Agriculture in Salt Lake City. The laboratory was moved to Logan in 1960.

Dr. Owen made a number of outstanding contributions in the breeding of sugar beet varieties resistant to curly top. He took a major part in the discovery and development of monogerm sugar beet seed. His discovery of a male-sterile plant in the spring of 1951 at St. George made possible the development of hybrid sugar beets.

He belonged to many scientific and honorary societies and received many honors for outstanding service in his chosen field.

Dr. Owen is survived by his wife, Bernita M. O'Neal Owen and a son, Kipling Herbert, and a daughter, Judith Ann.

### **D. W. PITTMAN**

Don Warren Pittman, retired professor of agronomy, died suddenly while working in his avocado grove near Vista, California, on September 1, 1963.

As a member of the Experiment Station staff Professor Pittman's research extended over such broad areas as tillage, dry farming, fertilizer usage, new crops, saline and

alkali soils, irrigation, crop rotations, and soil microscopy. He did some of the early work in the state on use of commercial fertilizers. He was the author of a book, "Soil, the Foundation of Agriculture," published in the 1930's. In addition to his research activities, part of his time was spent in teaching classes in agronomy.

Professor Pittman attended the second International Congress of Soil Science in Moscow, USSR, in 1930. He spent the years 1940 to 1943 in Iran as a consultant on soils and crops and was in China for a year in 1946 helping to establish a sugar beet industry.

He took his B. S. degree in agronomy at Iowa State College in 1914. Following graduation he taught at Monticello, Utah, high school for a year and then came to the Utah Agricultural College to work on a master's degree. He remained at Utah State as a staff member from that time until his retirement on June 30, 1957.

He is survived by his wife, Blanche Condit Pittman, former editor of Experiment Station publications.

### **DAVID V. KOPLAND**

Death after a brief illness in September terminated a fruitful career of dairy research for David V. Kopland.

During 32 years with the USDA Dairy Field Station at Huntley, Montana, he and colleagues conducted extensive research and published their findings on pasture management, feeding cows for milk production, proved sires, and other breeding experiments. He was in charge of dairy work at the Huntley station for more than 20 years before moving to Utah State University with the USDA herd in 1961 to continue his devoted dairy studies here.

He was a native of Wellington, Kansas, and a graduate from South Dakota State College. His wife, Janet Buyers Kopland, is living at Hyde Park, Utah.

## NEW PUBLICATIONS

Electrification leaflet 29. Electricity, the dairyman's helper, by Paul W. Petersen. 4 p.

This leaflet explores ways that electricity can save time and labor and improve the efficiency of the dairy operation through the mechanization of milking and the handling of the milk.

Electrification leaflet 30. Proper fusing and overload protection on electric motors, by P. W. Petersen. 4 p.

This leaflet discusses the maintenance needs of electric motors such as cleaning, oiling, replacing of brushes, bushings and bearings, belt alignment, checking voltage, and providing for overload protection and proper fusing.



# research reports



## Plant production and water usage

SCIENTISTS at Utah State University have discovered that plants with "cold feet" don't use as much water as they would under more comfortable circumstances. On the other hand, neither will they be as productive. Plants apparently are as responsive to physical comfort as we are.

Some basic research by R. K. Tew, S. A. Taylor, and G. L. Ashcroft has thrown new light on the "why's" of plant production and water usage. In today's world, most people can pretty well control their environment. If it rains, we can keep dry; if it is too hot, we can seek shade; if it is cold, we can turn up the furnace. But the plant has to endure what we and nature provide.

By learning more about why and how plants react to certain conditions, scientists hope to maximize water conservation possibilities and crop productivity.

The recent USU laboratory experiments have definitely established that the temperature of the soil along with that of the surrounding air determines a plant's rate of transpiration. And a plant's transpiration rate is of vital concern to any one trying to grow a crop and get maximum value from available water. Transpiration involves the passage of water through the plant from the roots, to the leaves, to the atmosphere. Much of this transpired water is wasted. Relatively small amounts of water are used by the plant for growth and reproduction.

The scientists are now trying to figure out ways of reducing transpiration losses thus making more water available for crop growth.

## Influence of stress on sheep

THIRTY-SIX sheep, individually fed for forty months, showed that the combined stress of feed, seasons, and pregnancy will cause variations of five microns in wool fiber diameter during the year. Protein differentials of 5, 7, and 9 percent during a winter period of gestation changed wool fiber diameter. The protein levels did not have any influence on the average days of gestation per ewe, but they did result in a significant difference in the average pounds of lambs born.

John Butcher

## Increased use of frozen foods

IN LESS than a generation, frozen foods have grown from an uncertain infancy to a multi-million-dollar industry deeply influencing our food buying habits, bringing new convenience to the kitchens and tables of America, and providing an expanding market for farm products.

As we observe the tremendous variety — literally ranging from "soup" to "nuts" — that is available in the frozen food department of any grocery store, it's difficult to realize that virtually all of this has come about within the past 20 years.

Today's frozen food industry, accounting for more than 7 billion pounds of food with an estimated retail value of some \$4 billion, is certainly a modern marketing miracle. Practical methods of preserving food by freezing were developed in the 1920's — but the infant industry through the thirties was in the position of being "all dressed up with no place to go" since the facilities for marketing frozen products just didn't exist.

During the 1940's a whole new, spe-

cialized marketing system was developed. Transportation, packaging, storage and handling, and retail store merchandising techniques geared to moving frozen foods in volume have all been developed since World War II.

U. S. Department of Agriculture and experiment station research teams have made extensive studies on a wide variety of frozen foods to determine what happens under different storage temperatures for varying lengths of time. These time-temperature studies are aiding processors, distributors, and consumers to maintain the original high quality of frozen foods in storage and handling from the processing plant to the dinner table.

Other research has contributed to the development and precooked frozen foods using poultry and has helped develop improved methods of processing and freezing poultry meat.

## Junction angle does not affect efficiency of drain tile lines

UNDERGROUND agricultural drain tile lines can be laid more rapidly and at less expense — without impairing their efficiency — by joining side lines to the main at the most convenient angle.

Side lines (laterals) are customarily joined to the main line at a 45-degree angle. But research shows that designers can disregard the junction angle, since it has practically no effect on the operation of most agricultural drain tile systems.

The engineers say their findings may also be significant in designing other pipe systems — for example, those used for air conditioning, water supply, and some sewers.

Joining agricultural tile lines at a 45-degree angle has been costly. Where tile systems cannot be designed with the laterals approaching the main at 45 degrees, the trenching machine must be halted at each junction.





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*Wynne Thorne*  
Director

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### CONTRIBUTIONS TO RESEARCH August 1 to November 1, 1963

National Institutes of Health	\$108,624 for a graduate program in cancer research \$42,448 for graduate training in speech pathology and audiology \$13,752 for a study of the photo-chemistry of riboflavin
National Science Foundation	\$14,700 for an undergraduate science education program in wildlife resources \$9,100 for research equipment in chemistry \$8,750 for an undergraduate science education program in chemistry
Air Force Office of Scientific Research	\$14,748 for study of the effect of structural changes on the pyrolysis of esters of organic and inorganic acids
Air Force Research and Development Command	\$17,145 for a kinetic and substituent effect study in gas phase, homogeneous thermal decomposition of organic and inorganic esters, organic acids, and some of their nitrogen and sulfur analogues
Moroni Feed Company	\$7,000 for turkey production studies
U. S. Steel Corporation Columbia Geneva Division	\$6,600 for fluorine studies
Damon Runyon Memorial Fund for Cancer Research	\$6,000 for study of the genetic mechanism of maternal effect for tumorous head in <i>Drosophila melanogaster</i>
Climax Molybdenum Company	\$3,600 for study of the function of molybdenum in biological systems
Whirlpool Corporation	\$2,600 + a controlled atmosphere storage unit for fruit and vegetable storage studies
Ogden Grain Exchange	\$1,200 for wheat breeding studies
Waterman Loomis Company	\$300 for insect pollination investigations in legumes

### Insecticide residues found in wild pheasants

RESIDUES of insecticides have been found in tissues of a group of pheasants collected by personnel of the Utah Department of Fish and Game in the vicinity of Delta, Utah, in October of 1962. Dieldrin was detected in every bird and DDT was also present in most cases. Dieldrin in body fat ranged from 0.4 to 1.0 ppm and DDT, when present, from 0.5 to 3.5 ppm. In liver fat much greater quantities were found (dieldrin, 5 to 25 ppm; DDT, 10 to 110 ppm). The residues probably occurred because of the use of these insecticides in controlling insect pests of alfalfa.

The presence of these insecticides in such a minor food as pheasant would not be considered as hazardous to anyone eating them although the residues greatly exceed permitted levels in food (the tolerance for dieldrin is 0 ppm and 7 ppm for DDT in the fat of meat).

The striking difference between the amount of insecticide found in body fat and in liver fat is not generally observed in other animals and presents an interesting research topic. Comparison of these levels in pheasants with those found by other workers will be made. The possibilities of further research on the effects of these insecticides on the pheasant population should be explored.

J. C. Street, associate professor,  
Animal Husbandry

J. B. Low, leader, Utah Cooperative Wildlife Research Unit

Dryland wheat farmers of Box Elder County are purchasing a 40-acre parcel of land in northern Blue Creek Valley which will be given to Utah State University. The land will be used by the Agricultural Experiment Station as a research laboratory for the study of dry farming methods. This is the fourteenth off-campus research center under Station supervision.